MS2650/MS2660 Series
Spectrum Analyzer
Operation Manual
Vol. 1
(Basic Operating Instructions)

Fifth Edition

Read this manual before using the equipment.
Keep this manual with the equipment.

ANRITSU CORPORATION

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2004

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Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Insure that you clearly understand the meanings of the symbols BEFORE using the equipment.

Symbols used in manual

DANGER ⚠ This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

WARNING ⚠ This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

CAUTION ⚠ This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

(Some or all of the following five symbols may not be used on all Anritsu equipment. In addition, there may be other labels attached to products which are not shown in the diagrams in this manual.)

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

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

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

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

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

These indicate that the marked part should be recycled.

MS2650/MS2660 Series Spectrum Analyzer
Operation Manual Vol. 1 (Basic Operating Instructions)

July 1996 (First Edition)
June 1997 (Fifth Edition)

For Safety

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, before supplying power to the equipment, 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.

Repair

WARNING ⚠

3. This equipment cannot be repaired by the user. DO NOT attempt to open the cabinet or to disassemble internal parts. Only Anritsu-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 precision 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 Safety

WARNING ⚠

LCD

5. This instrument uses a Liquid Crystal Display (LCD);
DO NOT subject the instrument to excessive force or drop it. If the LCD is subjected to strong mechanical shock, it may break and liquid may leak.
This liquid is very caustic and poisonous.
DO NOT touch it, ingest it, or get in your eyes. If it is ingested accidentally, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

Battery fluid

6. DO NOT short the battery terminals and never attempt to disassemble it or dispose of it in a fire. If the battery is damaged by any of these actions, the battery fluid may leak.
This fluid is poisonous.
DO NOT touch it, ingest it, or get in your eyes. If it is accidentally ingested, spit it out immediately, rinse your mouth with water and seek medical help. If it enters your eyes accidentally, do not rub your eyes, irrigate them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

For Safety

CAUTION ⚠

Changing Fuse

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 of the cabinet.

CAUTION ⚠

T5A 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. MS2651A/2661A
   - Maximum DC voltage ratings:
     RF Input ±50 Vdc
     TG Output 0 Vdc
   - Maximum AC power ratings:
     RF Input +30 dBm
     −10 dBm — When Option 08 Pre-amplifier is mounted.
     TG Output +20 dBm
   - NEVER input a >+30 dBm(+10 dBm for Option 08) and >±50 Vdc power to RF Input.
   - NEVER input a >0 Vdc (when Option 19 DC coupling input is mounted) power to RF Input.
   - NEVER input a >+20 dBm and >0 Vdc reverse power to TG Output.
   - Excessive power may damage the internal circuits.

   MS2653A/2663A
   - Maximum DC voltage ratings:
     RF Input 0 Vdc
   - Maximum AC power ratings:
     RF Input +30 dBm
   - NEVER input a >+30 dBm and >0 Vdc power to RF Input.
   - Excessive power may damage the internal circuits.

For Safety

CAUTION ⚠

Replacing Memory Back-up Battery

4. The power for memory backup is supplied by a Poly-carbonmonofluoride Lithium Battery. This battery should only be replaced by a battery of the same type; since replacement can only be made by Anritsu, contact the nearest Anritsu representative when replacement is required.

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

Storage Medium

5. This equipment stores data and programs using Plug-in Memory card (MC).
   Data and programs may be lost due to improper use or failure.
   ANRITSU therefore recommends that you backup the memory.

   ANRITSU CANNOT COMPENSATE FOR ANY MEMORY LOSS.

   Please pay careful attention to the following points.

   - Do not remove the IC card from equipment being accessed.
   - Isolate the card from static electricity.
   - The backup battery in the SRAM memory card has a limited life; replace the battery periodically.

   For replacing the battery, see page 2-11 of this Operation Manual.

Disposing of The Product

6. This equipment uses chemical compound semiconductor including arsenide.
   At the end of its life, the equipment should be recycled or disposed properly according to the local disposal regulations.

Equipment Certificate

Anritsu Corporation certifies that this equipment was tested before shipment using calibrated measuring instruments with direct traceability to public testing organizations recognized by national research laboratories including the Electrotechnical Laboratory, the National Research Laboratory and the Communication Research laboratory, and was found to meet the published specifications.

Anritsu Warranty

Anritsu Corporation will repair this equipment free-of-charge if a malfunction occurs within 1 year after shipment due to a manufacturing fault, provided that this 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 a non-specified power supply or in a non-specified installation location.

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

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

Anritsu Corporation Contact

If this equipment develops a fault, contact the head office of Anritsu Corporation at the address in the operation manual, or your nearest sales or service office listed on the following pages.

Front Panel Power Switch

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

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

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

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

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

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

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

ABOUT DETECTION MODE

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

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

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

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

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

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

CE Marking

Anritsu affix the CE Conformity Marking on the following product (s) accordance with the Council Directive 93/68/EEC to indicate that they conform with the EMC directive of the European Union (EU).

CE Conformity Marking

CE

1. Product Name/Model Name

Product Name: Spectrum Analyzer

Model Name: MS2651A and MS2661A Option 20
MS2653A and MS2663A

2. Applied Directive

EMC : Council Directive 89/336/EEC

Safety: Council Directive 73/23/EEC

3. Applied Standards

EMC:

Electromagnetic radiation:

EN55011(ISM, Group 1, Class A equipment)

Immunity:

EN50082-1

		Performance Criteria*
IEC801-2 (ESD)	4 kVCD, 8 kVAD	B
IEC801-3 (Rad.)	3 V/m	A
IEC801-4 (EFT)	1 kV	B

*: Performance Criteria

A: No performance degradation or function loss

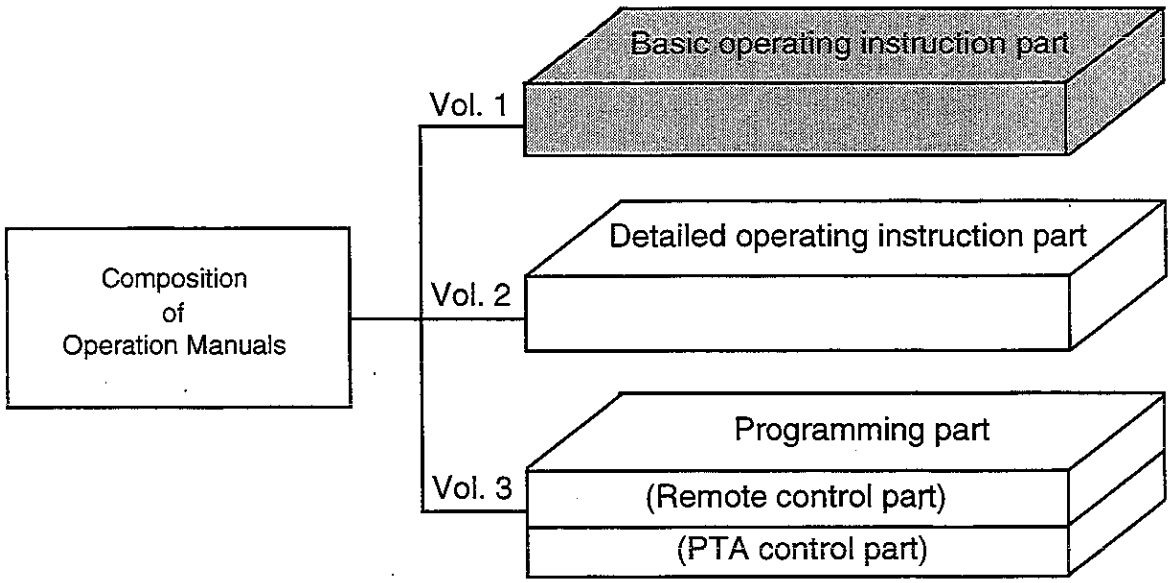
B: Self-recovered temporary degradation of performance or temporary loss of function

Safety: EN61010-1 (Installation Category II, Pollution Degree 2)

ABOUT THIS MANUAL

(1) Composition of MS2650/MS2660 Series Operation Manuals

The MS2650/MS2660 series Spectrum Analyzer operation manuals of the standard type are composed of the following three documents. Use them properly according to the usage purpose.



Basic operating instruction part: Basic Operating Instructions: Provides information on the MS2650/MS2660 Series outline, preparation before use, panel description, basic operation, soft-key menu and performance tests.

Detailed operating instruction part: Detailed Operating Instructions: Provides information on the detailed panel operating instructions on MS2650/MS2660 Series that expand on the basic operation and soft-key menu in the Basic Operating Instruction Part.

Programming part: Composed of the Remote Control Part and PTA Control Part. The Remote Control Part provides information on RS-232C remote control, GPIB remote control and sample programs, while the PTA Control Part describes about PTA operation and PTL commands.

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SECTION 1

GENERAL

This section outlines the MS2650/MS2660 Series Spectrum Analyzer and explains the composition of this manual, the configuration of the MS2650/MS2660 Series with the standard accessories, the options, the optional accessories, and peripherals for expanding the MS2650/MS2660 Series capabilities, and the MS2650/MS2660 Series specifications.

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SECTION 1
GENERAL

Product Outline

The MS2650/MS2660 Series spectrum analyzer (henceforth called "this unit") is a portable type color LCD spectrum analyzer suited for signal analyses of radio equipment where the efficiency of frequency usage is increased and equipment are increasingly speeded and digitized.
Adopts the synthesizer local system and can cover a frequency range of 9 kHz to 3 GHz(when Option 19 DC coupling input is mounted: 500Hz to 3GHz) (MS2651A/2661A), 9 kHz to 8.1 GHz (MS2653A/2663A).
Excellent in basic performance such as C/N, distortion, frequency/level accuracy, and easily operable 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 is corrected by built-in calibration data, it allows high-accuracy level measurement for a wide range.
As the switching of waveforms between frequency domain and time domain can be done by a touch and two waveforms are simultaneously displayed, signal analyses of both domains can be done efficiently. Moreover, our original zone marker function and multi-marker function (up to 10 markers) are also special mention.

This unit provides the MEASURE function that 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, leak power from neighboring channels, etc.
In addition, as the template measurement of burst mean power and burst waveform are also available, it is suited for evaluating the performance of digital radio equipment.

■ Application

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

- AM / FM radio equipment
- Digital cellular telephone / cordless telephone
- Satellite broadcasting, CATV and TV equipment
- Small-capacity microwave equipment

Because of difference in basic performance such as sideband noise, mean noise level and strain dynamic range, the MS2660 series is suited for production and building, and the MS2650 series for maintenance.

Composition of Operation Manual

This Operation Manual is composed of 7 sections and appendixes A and B. The profile of each section is shown below.

Section conposition	Explanation
SECTION 1 GENERAL	Product outline, standard configuration, options, applicable parts, peripheral devices, and specifications
SECTION 2 PREPARATIONS BEFORE USE	Operations to be done before applying power
SECTION 3 PANEL DESCRIPTION	Description about the front and rear panels
SECTION 4 SOFT-KEY MENU	Description using a soft-key menu
SECTION 5 BASIC OPERATION PROCEDURE	Basic operation procedures for operation guide
SECTION 6 PERFORMANCE TESTS	Tests used for checking performance
SECTION 7 STORAGE AND TRANSPORTATION	Cautions on storage and transportation
APPENDIX A	FRONT AND REAR PANEL LAYOUT
APPENDIX B	BLOCK DIAGRAM

Equipment Configuration

This paragraph describes the configuration of the MS2650/MS2660 series Spectrum Analyzer with standard accessories and the various options to expand the functions.

Standard configuration

The table below shows the configuration of the MS2650/MS2660 series spectrum analyzer with the standard accessories.

Standard Composition

Item	Model / Order NO.	Name	Qty.	Rmarks
Main instrument	MS2651A/MS2661A MS2653A/MS2663A	Spectrum Analyzer	1	
Accessories	J0017F	Power cord	1	Approx. 2.5 m
	J0266	Power cord adaptor	1	3-pole to 2-pole conversion
	F0013	Fuse	2	T5 A 250 V
	W1154AE	Operation manual	1	

Options

The table below shows the options for the MS2650/MS2660 series which are sold separately.

Model † - Order No. †	Name	Remarks
MS2651A/MS2661A/ MS2653A/MS2663A-01	Reference crystal oscillator	Stability: $\leqq 2\times10^{-8}$ / day
MS2661A/MS2663A-02	Narrow resolution bandwidth	30 Hz, 100 Hz, 300 Hz
MS2651A/MS2661A/ MS2653A/MS2663A-03	Frequency counter	Resolustion: 1 Hz
MS2651A/MS2661A/ MS2653A/MS2663A-04	High-speed time domain sweep	1.25 µs / div
MS2651A/MS2661A/ MS2653A/MS2663A-05	FM demodulated waveform display function	2 kHz / div to 200 kHz / div
MS2651A/MS2661A/ MS2653A/MS2663A-06	Trigger / gate circuit	Pre-trigger and post trigger available (Option 16 required for TV trigger)
MS2651A/MS2661A/ MS2653A/MS2663A-07	AM / FM demodulator (voice monitor)	Output to loudspeaker or earphone connector
MS2651A/MS2661A-08	Pre-amplifier	100 kHz to 3 GHz, 20 dB
MS2651A/MS2661A/ MS2653A/MS2663A-09	GPIB interface	Not possible when Option 10 installed
MS2651A/MS2661A/ MS2653A/MS2663A-10	Parallel interface	Not possible when Option 09 installed
MS2651A/MS2661A/ MS2653A/MS2663A-11	Memory card interface	PCMCIA Ver. 2.0 Type I, 2 slots
MS2661A/MS2663A-12	QP Detector	QP RBW:200 Hz, 9kHz, 120kHz
MS2651A/MS2653A-13	QP Detector	QP RBW:9kHz, 120kHz
MS2651A/MS2661A/ MS2653A/MS2663A-14	PTA Parallel I/O	Controlling external equipment from PTA. Possible when Option 09 installed Not possible when Option 10 installed
MS2651A/MS2661A/ MS2653A/MS2663A-15	Sweep signal output	X, Z
MS2651A/MS2661A-16	Television monitor	NTSC / PAL (Option 08 required at same time. In addition, Option 07 required for audio.)
MS2661A-19	DC coupling input	Expanding Received frequency to 500 Hz when DC coupling input circuit. Option 02 required at same time.
MS2651A/MS2661A-20	Tracking generator	100 kHz to 3 GHz, 0 to –60 dBm

† Please specify the model / order number, name, and quantity when ordering.

Optional Accessories and Peripherals

The following table shows the optional accessories and peripherals for MS2650/MS2660 series which are all sold separately.

Optional Accesories

Model † - Order No. †	Name	Remarks
J0561	Coaxial cord, 1 m	N-P-5W · 5D-2W · N-P-5W
J0104A	Coaxial cord, 1 m	BNC-P · RG-55 / U · N-P-5W
JS256G3-C-13	256 kB memory card	Meets PCMCIA Ver. 2.0 Type I
JS512G3-C-13	512 kB memory card	Meets PCMCIA Ver. 2.0 Type I
JS1024G3-C-13	1024 kB memory card	Meets PCMCIA Ver. 2.0 Type I
JS2048G3-C-13	2048 kB memory card	Meets PCMCIA Ver. 2.0 Type I
B0329G	Protective cover	3 / 4 MW4U
B0395A	Rack mount kit (IEC)	
B0395B	Rack mount kit (JIS)	
J0055	Coaxial adaptor (NC-P·BNC-J)	
J0076	Coaxial adaptor (NC-P·F-J)	
B0391A	Carring case (hard type)	With casters
B0391B	Carring case (hard type)	Without casters
MP612A	RF Fuse Holder	DC to 1000 MHz, 50 Ω (N)
MP613A	Fuse Element	For MP612A
MA8601A	DC Block Adaptor	50 Ω (10 kHz to 2.2 GHz)
MA2507A	DC Block Adaptor	50 Ω (9 kHz to 3.0 GHz)
MP1621A	50 Ω → 75 Ω Impedance Transformer	9 kHz to 3 GHz, with DC block capacitor (allowable voltage: 100 V)
MP614A	50 Ω ⟷ 75 Ω Impedance Transformer	10 to 1200 MHz (transformer type)
J0121	Coaxial cord, 1 m	NC-P-3W • 3C-2WS • NC-P-3W
J0308	Coaxial cord, 1 m	BNC-P • 3C-2WS • NC-P-3W
J0063	Fixed attenuator for high power	30 dB (10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power	30 dB (10 W, DC to 9 GHz)
MP640A	Branch	40 dB, DC to 1700 MHz
MP654A	Branch	30 dB, 0.8 to 3 GHz
MP520A	CM Directional Coupler	25 to 500 MHz, 75 Ω (NC)
MP520B	CM Directional Coupler	25 to 1000 MHz, 75 Ω (NC)
MP520C	CM Directional Coupler	25 to 500 MHz, 50 Ω (N)
MP520D	CM Directional Coupler	25 to 1000 MHz, 50 Ω (N)
MP526A	High Pass Filter	60-MHz band
MP526B	High Pass Filter	150-MHz band
MP526C	High Pass Filter	250-MHz band
MP526D	High Pass Filter	400-MHz band
MP526G	High Pass Filter	27-MHz band
J0007	GPIB cable, 1 m	408JE-101
J0008	GPIB cable, 2 m	408JE-102
J0743A	RS-232C cable, 1 m	For IBM PC / AT or compatible, D-sub 9 pins

† Please specify the model / order number, name, and quantity when ordering.

Specifications

Model			MS2651A	MS2661A
Frequency	Frequency range		9 kHz to 3 GHz	9 kHz to 3 GHz. Option19:500 Hz to 3 GHz
	Center frequency display accuracy		± (display frequency × reference frequency accuracy + span × span accuracy + 100 Hz) Span ≧ 10 kHz. after calibration	
	Marker frequency display accuracy		Normal: Same as center frequency display accuracy. Delta: Same as frequency span accuracy	
	Frequency span		Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ± 2.5% (span: ≧ 10 kHz), ± 5% (span: < 10 kHz with option 02)	
	Resolution bandwidth (3 dB BW)		Setting range: 1 kHz. 3 kHz. 10 kHz. 30 kHz. 100 kHz. 300 kHz. 1 MHz. 5 MHz (manually or automatically settable according to frequency span) * Option 02 (MS2661A only): 30 Hz. 100 Hz and 300 Hz are added. Measurements of such as noise. C/N. adjacent channel leakage power by measure function are executed with the calculated equivalent noise bandwidth of the resolution bandwidth.	
	Selectivity (60 dB: 3 dB)		≦ 10: 1 (RBW: 1 to 300 kHz) ≦ 15: 1 (RBW: 1 MHz. 5 MHz)	
	Video bandwidth		1 Hz to 3 MHz (1-3 sequence). automatically settable for through. manual or span)	
	Signal purity and stability		Noise sidebands: ≦ − 90 dBc/Hz (1 GHz. 10 kHz offset)	Noise sidebands: ≦ − 100 dBc/Hz (1 GHz. 10 kHz offset)
			Residual FM: ≦ 20 Hzp-p/0.1 s (1 GHz. span: 0 Hz) Frequency drift: ≦ 200 Hz/min (span: ≦ 10 kHz, sweep time: ≦ 100 s) *After 1-hour warm-up at constant ambient temperature	
	Reference oscillator		Frequency: 10 MHz Aging rate: 2 × 10 $^{-6}$/year (typical): Option 01: 1 × 10 $^{-7}$/year. 2 × 10 $^{-8}$/day Temperature characteristics: 1 × 10 $^{-5}$ (typical. 0° to 50°C): Option 01: ± 5 × 10 $^{-8}$ (0° to 50°C)	
Amplitude	Level measurement	Measurement range	Average noise level to +30 dBm	
		Maximum input level	+30 dBm (CW average power. input attenuator ≧ 10 dB). ± 50 Vdc	
		Average noise level	≦ − 110 dBm (1 MHz to 1 GHz). ≦ − 110 dBm + f [GHz] dB (> 1 GHz) * Resolution bandwidth 1 kHz. video bandwidth 1 Hz. input attenuator 0 dB	≦ − 115 dBm (1 MHz to 1 GHz). ≦ − 115 dBm + f [GHz] dB (> 1 GHz) * Resolution bandwidth 1 kHz. video bandwidth 1 Hz. input attenuator 0 dB When Option-08 Pre-amplifier installed: ≦ − 114 dBm(1 MHz to 1 GHz) ≦ − 114 dBm + 1.5f[GHz] dB(>1 GHz)
		Residual response	≦ − 100 dBm (input attenuator: 0 dB)	
	Total level accuracy		± 1.1 dB Total level accuracy: reference level accuracy (0 to − 50 dBm) + frequency response + log linearity (0 to − 20 dB) + calibration signal accuracy	
	Reference level		Setting range Log scale: − 100 to +30 dBm. or equivalent level Linear scale: 224 µV to 7.07 V Unit Log scale: dBm. dBµV. dBmV. V. dBµVemf. W. dBµV/m Linear scale: V Reference level accuracy: ±0.3 dB (− 49.9 to 0 dBm). ± 0.75 dB (− 69.9 to − 50 dBm. 0.1 to +30 dBm). ±1.5 dB (− 80 to − 70 dBm) *After calibration at 100 MHz frequency. span 2 MHz (when input attenuator. resolution bandwidth. video bandwidth. and sweep time set to AUTO) Resolution bandwidth switching deviation: ±0.3 dB Input attenuator Setting range: 0 to 70 dB (10 dB steps) *Manual settable. or automatically settable according to reference level Switching deviation: ±0.3 dB (0 to 50 dB). ±1 dB (0 to 70 dB) *After calibration. frequency 100 MHz. input attenuator 10 dB	

(Continued)

	Model	MS2651A	MS2661A
Amplitude	Frequency response	±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C) ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 0 to 50 dB) ±1.5 dB (9 kHz to 100 kHz, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C)	
	Screen display	Scale: 10 div (at single scale) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1% Linearity (after calibration): Log scale: ±0.3 dB (0 to − 20 dB, RBW ≦ 1 MHz), ±1 dB (0 to − 70 dB, RBW ≦ 100 kHz), ±1.5 dB (0 to − 80 dB, RBW ≦ 10 kHz), ± 2.5 dB (0 to − 90 dB, RBW ≦ 10 kHz). Linear scale: ±3% (compared to reference level) Marker level resolution: Log scale: 0.01 dB Linear scale: 0.01% of reference level	
	Spurious response	2nd harmonic distortion: − 55 dBc (10 to 100 MHz, mixer level − 30 dBm) − 60 dBc (100 to 1500 MHz, mixer level − 30 dBm) Two signal 3rd intermodulation distortion: − 70 dBc (10 MHz to 3 GHz, frequency difference of two signals >50 kHz, mixer input level − 30 dBm)	2nd harmonic distortion: − 60 dBc (10 to 200 MHz, mixer level − 30 dBm) − 75 dBc (200 to 1500 MHz, mixer level − 30 dBm) − 80 dBc (800 to 1000 MHz, mixer level − 30 dBm) Two signal 3rd intermodulation distortion: − 70 dBc (10 to 100 MHz), − 80 dBc (100 to 3 GHz) *Frequency difference of two signals >50 kHz, mixer input level − 30 dBm
	1 dB gain compression	≧ − 5 dBm (≧ 100 MHz, at mixer input level)	
	Maximum dynamic range	1-dB gain compression level vs. average noise level: >105 dB, >105 dB − f [GHz] dB Distortion characteristics (1 kHz RBW): 2nd harmonic: >67.5 dB (10 to 100 MHz), >70 dB (100 to 500 MHz), >70 − f [GHz] dB (500 to 1000 MHz) 3rd intermodulation: >76.7 dB (10 to 1000 MHz), >76.7 − 2/3f [dB] (1 to 3 GHz)	1-dB gain compression level vs. average noise level: >110 dB (100 MHz to 1 GHz), >110 dB − f [GHz] dB (>1 GHz) When Option-08 Pre-amplifier installed: ≧ − 109 dB (1 MHz to 1 GHz) ≧ − 109 dB + 1.5f (GHz) dB (>1 GHz) Distortion characteristics (1 kHz RBW): 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 − f [GHz] dB (500 to 1500 MHz) 3rd intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (100 to 1000 MHz), >83.3 − 2/3f [GHz] dB (1 to 3 GHz)
Sweep	Sweep time	Setting range: 20 ms to 1000 s (automatically for manual set, span, resolution bandwidth, and video bandwidth) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1100 s), ±1% (time domain sweep)	
	Sweep mode	Continuous, single.	
	Zone sweep	Sweeps only in frequency range indicated by zone marker	
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)	
Functions	Number of data points	501	
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching error: ±0.5 dB (at reference level)	
	Display	Color TFT-LCD Size: 5.7" Number of colors: 17 (RGB, each 64-scale settable)	

(Continued)

Model		MS2651A	MS2661A
Functions	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously, simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously Trace-move/calculation: A → B, B → A, A ←→ B, A+B → A, A-B → A, A-B+DL → A	
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE , OVER WRITE	
	Input connector	N-J, 50 Ω	
	Auxiliary signal input and output	IF OUTPUT: 455 kHz (RBW ≦ 30 kHz), 10.695 MHz (RBW ≧ 100 kHz), − 10 dBm ±2 dB (100 MHz, at upper edge of display, 50 Ω), BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz input, 75 Ω termination, LOG: 10 dB/div, from lower edge to upper edge, BNC connector) COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ± 10 Hz, 2 to 5 Vp-p, ≧ 200 Ω, BNC connector	
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL	
	Zone marker	NORMAL, DELTA	
	Marker	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, Δ MARKER → SPAN, ZONE → SPAN	
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP	
	Multi-marker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)	
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch) channel power (dBm/Hz, dBm), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, reference level method, inband channel power method, channel designate display: 2 channels × 2, graphic display), average power of burst signal (average power in designated time range of time domain waveform), template comparison (upper/lower limits × each 2, time domain), MASK (upper/lower × each 2, frequency domain)	
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max. 12) or memory card (Option 11)	
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via the RS-232C, GPIB (Option 09), or parallel (Option 10) interface Plotter (HP-GL, GP-GL or compatible models): Display data can be output via the RS-232C, and GPIB (Option 09) interface	
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card (Option 11), upload/download to/from external computer Programming capacity: 192 Kbyte Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions	
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)	
Others	Power	85 to 132 Vac/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≦ 200 VA (100 Vac), ≦ 220 VA (200 Vac)	
	Dimensions and mass	177 (H) × 320 (W) × 351 (D) mm, <10.4 kg (without option, <9.8 kg when handle is removed)	
	Ambient temperature	0° to 50°C (operate), − 30° to +75°C (storage)	

Model			MS2653A	MS2663A
Frequency	Frequency range		9 kHz to 8.1 GHz	
	Frequency band		Band 0 (0 to 3.2 GHz), band 1– (3.2 to 6.5 GHz), band 1+ (6.4 to 8.1 GHz)	
	Pre-selector range		3.1 to 8.1 GHz (band 1–, 1+)	
	Center frequency display accuracy		± (display frequency × reference frequency accuracy + span × span accuracy + 100 Hz) *Span: ≥10 kHz, after calibration	
	Marker frequency display accuracy		Normal: Same as center frequency display accuracy, Delta: Same as frequency span accuracy	
	Frequency span		Setting range: 0 Hz, 1 kHz to 8.2 GHz Accuracy: ±2.5% (span: ≥10 kHz)	Setting range: 0 Hz, 1 kHz to 8.2 GHz Accuracy: ±2.5% (span: ≥10 kHz), ±5% (span: <10 kHz, Option 02 installed)
	Resolution bandwidth (3 dB BW)		Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 5 MHz (manually or automatically settable according to frequency span) *Option 02 (MS2663A only): 30 Hz, 100 Hz, and 300 Hz are added. Measurements of such as noise, C/N, adjacent channel leakage power by measure function are executed with the calculated equivalent noise bandwidth of the resolution bandwidth. Selectivity (60 dB : 3 dB): ≤10:1 (RBW: 1 kHz to 300 kHz), ≤15:1 (RBW: 1 MHz, 5 MHz)	
	Video bandwidth		1 Hz to 3 MHz (1-3 sequence), through *Manually or automatically settable according to resolution bandwidth	
	Signal purity and stability		Noise sidebands : ≤–90 dBc/Hz (1 GHz, 10 kHz offset)	Noise sidebands: ≤–100 dBc/Hz (1 GHz, 10 kHz offset)
			Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤1 M Hz, sweep time: ≤100 s) *After 1-hour warm-up at constant ambient temperature	
	Reference oscillator		Frequency: 10 MHz Aging rate: 2×10^{-6}/year (typical); Option 01: 1×10^{-7}/year, 2×10^{-8}/day Temperature characteristics: 1×10^{-5} (typical, 0° to 50°C); Option 01: $\pm 5 \times 10^{-8}$ (0° to 50°C)	
Amplitude	Level measurement	Measurement range	Average noise level to +30 dBm	
		Maximum input level	+30 dBm (CW average power, input attenuator: ≥10 dB), ±0 Vdc	
		Average noise level	≤–110 dBm (1 MHz to 1 GHz, band 0), ≤–110 dBm + f [GHz] dB (1 to 3.1 GHz, band 0) ≤–110 dBm + 0.5f [GHz] dB (3.1 to 8.1 GHz, band 1) *Resolution bandwidth: 1 kHz, video bandwidth: 1 Hz, input attenuator: 0 dB	≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0) ≤–115 dBm + 0.5f [GHz] dB (3.1 to 8.1 GHz, band 1) *Resolution bandwidth: 1 kHz, video bandwidth: 1 Hz, input attenuator: 0 dB
		Residual response	≤–95 dBm (input attenuator: 0 dB, input: 50 Ω termination, 1 MHz to 8.1 GHz)	≤–100 dBm (input attenuator: 0 dB, input: 50 Ω termination, 1 MHz to 8.1 GHz)
	Total level accuracy		±1.3 dB (100 kHz to 3.1 GHz), ±1.8 dB (3.1 to 8.1 GHz) *Level measurement accuracy after calibration using internal calibration signal Total level accuracy: reference level accuracy (0 to –50 dBm) + frequency response + log linearity (0 to –20 dB)	
	Reference level		Setting range Log scale: –100 to +30 dBm, or equivalent level Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµV (e.m.f), W , dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) * After calibration at 100 MHz frequency, span 1 MHz (when input attenuator, resolution bandwidth, video bandwidth, and sweep time set to AUTO) Resolution bandwidth switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (1 kHz to 5 MHz) *After calibration, referenced to resolution bandwidth 3 kHz Input attenuator Setting range: 0 to 70 dB (10 dB steps) *Manual settable, or automatically settable according to reference level Accuracy: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, referenced to frequency 100 MHz, input attenuator 10 dB	
	Frequency response		±0.5 dB (100 kHz to 3.2 GHz, band 0, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C) ±1.5 dB (9 to 100 kHz, band 0, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C) ±1.5 dB (3.1 to 8.1 GHz, band 1–/1+, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C) ±1.0 dB (100 kHz to 3.2 GHz, band 0, input attenuator 10 to 50 dB) ±3.0 dB (3.1 to 8.1 GHz, band 1–/+, input attenuator 10 to 50 dB) *At band 1–/1+, after pre-selector tuning	

(Continued)

	Model	MS2653A	MS2663A
Amplitude	CRT display	Scale: 10 div (at single scale) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤10 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤10 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB Linear scale: 0.02% of reference level	
	Spurious response	2nd harmonic distortion: ≤–55 dBc (10 to 100 MHz, band 0, mixer input level: –30 dBm) ≤–60 dBc (0.1 to 1.55 GHz, band 0, mixer input level: –30 dBm) ≤–100 dBc (1.55 to 4.05 GHz, band 1–/1+, mixer input level: –20 dBm) Two signal 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 8.1 GHz, frequency difference of two signals: ≥50 kHz, mixer input level: –30 dBm)	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input level: –30 dBm) ≤–75 dBc (0.2 to 1.3 GHz, band 0, mixer input level: –30 dBm) ≤–70 dBc (1.3 to 1.55 GHz, band 0, mixer input level: –30 dBm) ≤–80 dBc (0.8 to 1 GHz, band 0, mixer input level: –30 dBm) ≤–100 dBc (1.55 to 4.05 GHz, band 1–/1+, mixer input level: –20 dBm) Two signal 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz) * Frequency difference of two signals: ≥50 kHz, mixer input level: –30 dBm
		Image response: ≤–70 dBc, Multiple response: ≤–70 dBc (band 1–/1+)	
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)	
	Maximum dynamic range	1 dB gain compression level to average noise level: >105 dB (100 MHz to 1 GHz, band 0), >105 dB –f[GHz] dB (1 to 3.1 GHz, band 0) >105 dB –0.5f[GHz] dB (3.1 to 8.1 GHz, band 1–/1+) Distortion characteristics (1 kHz RBW) 2nd harmonic: >67.5 dB (10 to 100 MHz) >70 dB (100 to 500 MHz) >70 –0.5f[GHz] dB (0.5 to 1.55 GHz) >95 –0.25f[GHz] dB (1.55 to 4.05 GHz) 3rd order intermodulation: >73.3 dB (10 to 1000 MHz) >73.3 –2/3f[GHz] dB (1 to 3.1 GHz) >73.3 –1/3f[GHz] dB (3.1 to 8.1 GHz)	1 dB gain compression level to average noise level: >110 dB (100 MHz to 1 GHz, band 0), >110 dB –1.5f[GHz] dB (1 to 3.1 GHz, band 0) >110 dB –0.5f[GHz] dB (3.1 to 8.1 GHz, band 1–/1+) Distortion characteristics (1 kHz RBW) 2nd harmonic: >72.5 dB (10 to 200 MHz) >80 dB (200 to 500 MHz) >80 –0.75f[GHz] dB (0.5 to 1.3 GHz) >82.5 –0.75f[GHz] dB (0.8 to 1 GHz) >77.5 –0.75f[GHz] dB (1.3 to 1.55 GHz) >97.5 –0.25f[GHz] dB (1.55 to 4.05 GHz) 3rd order intermodulation: >75 dB (10 to 100 MHz) >81.6 dB (100 to 1000 MHz) >81.6 –f[GHz] dB (1 to 3.1 GHz) >81.6 –1/3f[GHz] dB (3.1 to 8.1 GHz)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (manual settable, or automatically settable according to span, resolution bandwidth, and video bandwidth) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep)	
	Sweep mode	Continuous, single	
	Zone sweep	Sweeps only in frequency range indicated by zone marker	
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)	
Functions	Number of data points	501	
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)	
	Display	Color TFT-LCD, Size: 5.7", Number of colors: 17 (RGB, each 64-scale settable)	
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously, simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously, alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously Trace move/calculation: A→B, B→A, A↔B, A+B→A, A–B→A, A–B+DL→A	

(Continued)

Model		MS2653A	MS2663A
Functions	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE	
	Input connector	N-J, 50 Ω	
	Auxiliary signal input and output	IF OUTPUT: BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated), BNC connector COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector	
	Signal search	AUTO TUNE, PEAK→CF, PEAK→REF, SCROLL	
	Zone marker	NORMAL, DELTA	
	Marker	MARKER→CF, MARKER→REF, MARKER→CF STEP SIZE, ΔMARKER→SPAN, ZONE→SPAN	
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP	
	Multi-marker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)	
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), Channel power (dBm/Hz, dBm), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, reference level method, inband channel power method, channel designate display: 2 channels × 2, graphic display), average power of burst signal (average power in designated time range of time domain waveform), template comparison (upper/lower limits × each 2, time domain), MASK (upper/lower × each 2, frequency domain)	
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max. 12) or memory card (Option 11)	
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via the RS-232C, GPIB (Option 09), and Centronics (Option 10) interface Plotter (HP-GL, GP-GL or compatible models): Display data can be output via the RS-232C, and GPIB (Option 09) interface	
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card (Option 11), upload/download to/from external computer Programming capacity: 192 Kbyte Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions	
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)	
	Correction	Autocorrection of MA1621A Impedance Converter insertion loss Correction accuracy (input attenuator: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB*1 (2 to 3 GHz)	
Others	Power	85 to 132 Vac/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≤280 VA	
	Dimensions and mass	177 (H) × 320 (W) × 351 (D) mm, ≤13.5 kg (12 kg*1: standard configuration)	
	Ambient temperature	0° to 50°C (operate), –30° to +75°C (storage)	

*1: Typical value for reference; not guaranteed specifications

● Option 03: Frequency counter

Resolution	1 Hz, 10 Hz, 100 Hz, 1 kHz
Accuracy	Display frequency × reference frequency accuracy ±1 count (when S/N is ≧20 dB)

● Option 04: High-speed time domain sweep

Sweep time	12.5 μs, 25 μs, 50 μs, 100 to 900 μs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

● Option 05: FM demodulation waveform display function

Demodulation range	2, 5, 10, 20, 50, 100, 200 kHz/div
Marker display	Accuracy: ±5% of full scale (referenced to center frequency after calibration, DC-coupled, RBW 5 MHz, VBW 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≦ 20 kHz/div, VBW: off, at 3 dB bandwidth), DC (50 Hz at AC-coupled) to 500 kHz (range: ≦ 50 kHz/div, VBW: off, at 3 dB bandwidth)

● Option 06: Trigger/gate circuit

Trigger switch		FREE RUN, TRIGGERED
Trigger source	EXT	Trigger level: ± 10 V (resolution: 0.1 V) Trigger slope : RISE/FALL
	VIDEO	Trigger level: −100 to 0 dB (log scale, resolution: 1 dB) Trigger slope: RISE/FALL
	WIDE IF VIDEO	Trigger level: High, Middle, or Low selectable Bandwidth: ≧ 20 MHz Trigger slope: RISE/FALL
	LINE	Frequency: 47 to 63 Hz (line lock)
	TV	System: NTSC, PAL Sync.: V-SYNC, H-SYNC (ODD/EVEN) *Option 16 required
Trigger delay	Pre-trigger	Displays waveform from previous max. 1 screen at trigger occurrence point Range: −time span to 0 s Resolution: time span/500
	Post trigger	Displays waveform from after max. 65.5 ms at trigger occurrence point Range: 0 to 65.5 ms Resolution: 1 μs
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 μs) Gate width: 2 μs to 65.5 ms (from gate delay point, or external control, resolution: 1 μs)

● Option 07: AM/FM demodulator (voice monitor)

Voice output	With internal loudspeaker and earphone connector (φ 2.5 mini jack), adjustable volume

• Option 08: Pre-amplifier

Model	MS2651A	MS2661A
Frequency range	100 kHz to 3 GHz	
Gain	20 dB ±2 dB(after calibration)	
Noise figure	≦ 7 dB(<2 GHz), ≦ 12 dB(≧ 2 GHz) (typical value)	
Amplitude Level measurement Measurement range Maximum input level Average noise level	 Average noise level to 10 dBm +20 dBm(CW average power, input attenuator ≧ 10 dB), ±50 Vdc ≦ − 130 dBm(1 MHz to 1 GHz) ≦ − 130 dBm +1.5f[GHz] dB(>1 GHz) *Resolution bandwidth 1 kHz, video bandwidth 1 kHz, input attenuator 0 dB	 ≦ − 134 dBm(1 MHz to 1 GHz) ≦ − 134 dBm +2f[GHz] dB(>1 GHz) *Resolution bandwidth 1 kHz, video bandwidth 1 kHz, input attenuator 0 dB
Reference level	Setting range Log scale: − 120 to +10 dBm, or equivalent level Linear scale: 22.4 μ V to 707 mV Reference level accuracy: ±0.5 dB(− 69.9 to − 20 dBm), ±0.75 dB(− 89.9 to − 70 dBm, − 19.9 to +10 dBm) *After calibration, at frequency 100 MHz, span 2 MHz(when input attenuator, resolution bandwidth, video bandwidth, and sweep time set to AUTO.) Resolution bandwidth switching deviation: ±0.5 dB Input attenuator switching deviation: ±0.5 dB(0 to 50 dB), ±1 dB(0 to 70 dB) *After calibration, frequency 100 MHz, referenced to attenuation 10 dB	
Frequency response	±2.0 dB(100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 0 to 50 dB)	
Screen display	Linearity(after calibration) Log scale: ±0.5 dB(0 to − 20 dB, RBW ≦ 1 MHz) ±1 dB (0 to − 60 dB, RBW ≦ 100 kHz) ±1.5 dB(0 to − 75 dB, RBW ≦ 10 kHz) Linear scale: ±5%(compared to reference level)	
Spurious response	Two-signal 3rd-intermodulation distortion: − 70 dBc(10 MHz to 3 GHz) *Frequency difference of two signals >50 kHz, pre-amplifier input level − 55 dBm	
1-dB gain compression	≧ − 35 dBm(≧ 100 MHz, pre-amplifier input level)	

● Option 09: GPIB interface

Functions	Meets IEEE488.2. Can be controlled as device from external computer (excluding power switch). Or can control external equipment as controller
Interface	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28

● Option 10: Parallel interface

Function	Output data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

● Option 11: Memory card interface

Functions	Save/recall measurement settings and data. Uploads/downloads PTA programs. Accesses SRAM, EPROM, and flash EEROM (writes to SRAM only). Supports cards up to 2 MB.
Connector	PCMCIA Ver. 2.0, 2 slots

● Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ± 1 V (≧ 100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

● Option 16: Television monitor* (under development)

Video	NTSC/PAL
Audio	Simultaneous monitor of video and audio needs Option 07

* Option 08 required

● Option 20: Tracking generator

Frequency range	100 kHz to 3 GHz
Output level	
Setting range	0 to −60 dBm
Setting resolution	0.1 dB
Accuracy	≦± 1.0 dB(at frequency 100 MHz, output level 0 dBm)
Flatness	≦± 1.5 dB(100 kHz to 3 GHz, output level 0 dBm, referenced to 100 MHz)
Linearity	≦± 1.0 dB(output level 0 to −30 dBm) ≦± 2.0 dB(output level −30 to −60 dBm) (100 kHz to 3 GHz, referenced to 0 dBm)
Spurious	
Harmnics	≦−20 dBc(output level 0 dBm)
Non-harmnics	≦−35 dBc(output level 0 dBm)
Tracking generator feed-through	≦−95 dBm(50 Ω termination at RF input connector of spectrum analyzer and output connector of tracking generator)
Output connector	N-J, 50 Ω

● Whether or not to mount options on the series devices

Option No.	MS2651A	MS2661A	MS2653A	MS2663A
01: Reference crystal oscillator	○	○	○	○
02: Narrow resolution bandwidth	×	○	×	○
03: Frequency counter	○	○	○	○
04: High-speed time domain sweep	○	○	○	○
05: FM demodulated waveform display function	○	○	○	○
06: Trigger / gate circuit	○	○	○	○
07: AM / FM demodulator (voice monitor)	○	○	○	○
08: Pre-amplifier	○	○	×	×
09: GPIB interface	○	○	○	○
10: Parallel interface	○	○	○	○
11: Memory card interface	○	○	○	○
12: QP detector (QP RBW: 200 Hz is mounted)	×	○	×	○
13: QP detector (QP RBW: 200 Hz is not mounted)	○	×	○	×
14: PTA parallel I/O	○	○	○	○
15: Sweep signal output	○	○	○	○
16: Television monitor	○	○	×	×
19: DC coupling input	×	○	×	×
20: Tracking generator	○	○	×	×

○: Can be mounted ×: Cannot be mounted

● Option 14: PTA parallel I/O*

Functions	Controlling external equipment from PTA
Interface	Output 8 bit TTL level x2 Input/Output 4 bit TTL level x2
Connector	Amphenore 36-pin

* Possible when Option 09 installed

● Option 12: PQ detector*

Function	QP detection When this option is mounted, RBW=100 Hz 3 dB bandwidth of Option 02 is modified to 150 Hz (representative value).		
6 dB bandwidth	bandwidth: 200 Hz, 9 kHz, 120 kHz accuracy: ±30% (at 18 to 28°C)		
Indicator Section	LOG scale, 5 dB/DIV, 10 scale marks Linearity ≤ ±2.0 dB/0 to -40 dB (CW signal, Reference level=60 dB μV, Input Attenuator =0 dB, at 18 to 28°C)		
Pulse Responsiveness	Response Corresponding to CISPR pulse (at DET mode: QP, 18°C to 28°C)		
		Repetition Frequency	Response
	120 kHz Bandwidth	1 kHz	-8.0±1.0 dB or less
		100 Hz	Standard
		20 Hz	+9.0±1.0 dB or less
		10 Hz	+14.0±1.5 dB or less
		2 Hz	+26.0±2.0 dB or less
		1 Hz	+28.5±2.0 dB or less
	9 kHz Bandwidth	1 kHz	-4.5±1.0 dB or less
		100 Hz	Standard
		20 Hz	+6.5±1.0 dB or less
		10 Hz	+10.0±1.5 dB or less
		2 Hz	+20.5±2.0 dB or less
		1 Hz	+22.5±2.0 dB or less
	200 Hz Bandwidth	100 Hz	-4.0±1.0 dB or less
		60 Hz	-3.0±1.0 dB or less
		25 Hz	Standard
		10 Hz	+4.0±1.0 dB or less
		5 Hz	+7.5±1.5 dB or less
		2 Hz	+13.0±2.0 dB or less
		1 Hz	+17.0±2.0 dB or less
QP ON/OFF Switching Deviation	≤ ±1.0 dB (PEAK, QP) (CW signal, at reference level -40 dB, at 18°C to 28°C after automatic calibration)		
Detection Mode	QP, AVERAGE		
Field Strength Measurement	Indication of the correction of waveform data by antenna factor of a designated antenna and measurement of field strength (dBμV/m). Built-in Antenna factor Dipole Antenna : MP534A/651A Log-Periodic Antenna : MP635A/MP666A Loop Antenna : MP414B User : Programmable through GPIB (OPT9) or RS232C (4 type) Saving/Loading to/from Memory Card (OPT11) possible.		

* Use of Option 02 at the same time is necessary.

● Option 13: PQ detector

Function	QP detection
6 dB bandwidth	bandwidth: 9 kHz, 120 kHz accuracy: ±30% (at 18 to 28°C)
Indicator Section	LOG scale, 5 dB/DIV, 10 scale marks Linearity ≤ ±2.0 dB/0 to -40 dB (CW signal, Reference level=60 dB µV, Input Attenuator =0 dB, at 18 to 28°C)
Pulse Responsiveness	Response Corresponding to CISPR pulse (at DET mode: QP, 18°C to 28°C) Repetition Frequency / Response 120 kHz Bandwidth: 1 kHz: -8.0±1.0 dB or less; 100 Hz: Standard; 20 Hz: +9.0±1.0 dB or less; 10 Hz: +14.0±1.5 dB or less; 2 Hz: +26.0±2.0 dB or less; 1 Hz: +28.5±2.0 dB or less 9 kHz Bandwidth: 1 kHz: -4.5±1.0 dB or less; 100 Hz: Standard; 20 Hz: +6.5±1.0 dB or less; 10 Hz: +10.0±1.5 dB or less; 2 Hz: +20.5±2.0 dB or less; 1 Hz: +22.5±2.0 dB or less
QP ON/OFF Switching Deviation	≤ ±1.0 dB (PEAK, QP) (CW signal, at reference level -40 dB, at 18°C to 28°C after automatic calibration)
Detection Mode	QP, AVERAGE
Field Strength Measurement	Indication of the correction of waveform data by antenna factor of a designated antenna and measurement of field strength (dBµV/m). Built-in Antenna factor Dipole Antenna : MP534A/651A Log-Periodic Antenna : MP635A/MP666A Loop Antenna : MP414B User : Programmable through GPIB (OPT9) or RS232C (4 type) Saving/Loading to/from Memory Card (OPT11) possible.

● Option 19: DC Coupling Input*

Function		DC coupling the input circuits of the main body and expanding the lower limit of reception frequency range to 500 Hz.
Frequency Range		500 Hz to 3.0 GHz
Amplitude	Max. Input Level	Continuous Wave Ave. Power: +30dBm (Input Attenuator ≥ 10 dB) DC Voltage: ±0 V
	Average Noise Level	Resolution Bandwidth at 30 Hz, Video Bandwidth at 1 Hz, and Input Attenuator at 0 dB: ≤ -80 dBm (500 Hz to 10 kHz) ≤ -90 dBm (100 kHz to 200 kHz) ≤ -110 dBm (200 kHz to 1 MHz)
	Frequency Characteristic	100 MHz, as a standard ±1.2 dB (500 Hz to 100 kHz) ±0.5 dB (100 kHz to 3.0 GHz)

* Use of Option 02 at the same time is necessary.

SECTION 2
PREPARATIONS BEFORE USE

This section explains the preparations and safety procedures that should be performed before using the MS2650/MS2660 series Spectrum Analyzer. The safety procedures are to prevent the risk of injury to the operator and damage to the equipment. Insure that you understand the contents of the pre-operation preparations before using the MS2650/MS2660 series.
For connecting the GPIB cable and setting the GPIB address, see the Remote Control part of the separate Operation Manual Vol.3.

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SECTION 2
PREPARATIONS BEFORE USE

Installation Site and Environmental Conditions

Locations to be avoided

The MS2650/MS2660 series spectrum analyzer operates normally at temperatures from 0 to 50 °C. However, for the best performance, the following locations should be avoided.

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

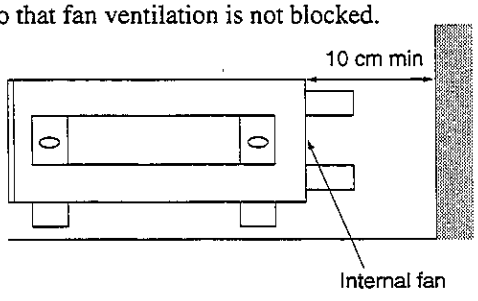
In addition to meeting the above conditions, to insure long-term trouble-free operation, the equipment should be used at room temperature and in a location where the power supply voltage does not fluctuate greatly.

CAUTION ⚠

If the MS2650/MS2660 series spectrum analyzer is used at normal temperatures after it has been used or stored for a long time at low temperatures, there is a risk of short-circuiting caused by condensation. To prevent this risk, do not turn the MS2650/MS2660 series on until it has been allowed to dry out sufficiently.

Fan clearance

To suppress any internal temperature increase, the MS2650/MS2660 series has a fan on the rear panel as shown in the diagram below. Leave a gap of at least 10 cm between the rear panel and the wall, nearby equipment or obstructions so that fan ventilation is not blocked.



Safety Measures

This paragraph explains the safety procedures which should be followed under all circumstances not to counter the risk of an accidental electric shock, damage to the equipment or a major operation interruption.

Power-on

WARNING ⚠

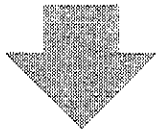
• Before power-on:	The MS2650/MS2660 series spectrum analyzer must be connected to protective ground. If the power is switched on without taking this countermeasure, there is a risk of receiving a accidental electric shock. In addition, it is essential to check the power supply voltage. If an abnormal voltage that exceeds the specified value is input, there is accidental risk of damage to the MS2650/MS2660 series and fire.
• During power-on	To maintain the MS2650/MS2660 series, sometimes it is necessary to make internal checks and adjustments with the covers removed while power is supplied. Very-high, dangerous voltages are used in the MS2650/MS2660 series, if insufficient care is taken, there is a risk of a accidental electric shock being received or of damage to the equipment. To maintain the MS2650/MS2660 series, request service by a service personnel who has received the required training.

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 kHz to 3 GHz (MS2651A/2661A)
9 kHz to 8.1 GHz (MS2653A/2663A)

Measurement level: Apply the measured signal with average noise level of up to + 30 dBm to the N-type connector RF Input of 50 Ω input impedance



CAUTION ⚠

The RF Input circuit is not protected against excessive power.
If a signal exceeding + 30 dBm is applied with input attenuator setting ≧10 dB, the input attenuator and input mixer may be burned.
When the Option-08 Preamplifier installed and the preamplifier ON; if a signal exceeding +10 dBm or +20 dBm is applied with input attenuator setting ≧0 dB or 10 dB, respectively, the input attenuator and input mixer may be burned.
⚠ is a warning mark to prevent such damage.

Installation

Rack mounting

The B0395A/0395B Rack Mount Kit (sold separately) is required to mount this unit in a rack. The installation method is included in the rack mount kit diagram.

Preparations before Power-on

This unit operates normally when it is connected to an 85 to 132 Vac, or 170 to 250 Vac (automatic voltage change) 47.5 to 63 Hz AC power supply. To prevent the following problems, take the necessary procedures described on the following pages before power is supplied.

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

Note:
- *The voltage and current rating are indicated on the rear panel when the instrument is shipped from the factory.*
- *In this manual, the power supply voltage and current ratings are represented by ** Vac and *** A, respectively.*

To protect the operator, the following WARNING and CAUTION notices are attached to the rear panel of the MS2651A/MS2661A.

WARNING ⚠
NO OPERATOR SERVICE-ABLE PARTS INSIDE.
REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION ⚠
FOR CONTINUED FIRE PRORECTION REPLACE ONLY WITH SPECIFIED TYPE AND RATED FUSE.

WARNING ⚠

Disassembly, adjustment, maintenance, or other access inside this instrument by unqualified personal should be avoided. Maintenance of this instrument should be performed only by Anritsu 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.

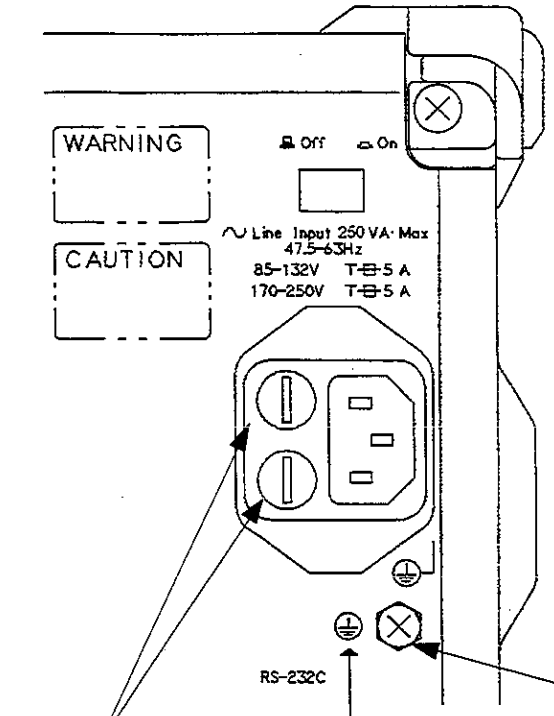
Protective grounding

(1) Grounding with 3-pole power outlet

When connecting to a 3-pole (grounded, 2-pole type) AC power-supply outlet, the frame of the MS2650/ MS2660 series is connected to ground potential. As a result, it is not necessary to connect the FG terminal to ground.

(2) Grounding with frame ground (FG) terminal

When there is no 3-pole AC power-supply outlet, the protective frame-ground (FG) terminal on the rear panel must be connected directly to ground potential.



Fuse holders

Label indicating protective ground terminal

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

WARNING ⚠

If power is supplied without protective grounding, there is a risk of accidental electric shock. When available, the protective frameground (FG) terminal on the rear panel, or the ground pin of the supplied power cord must be connected to ground potential before power is supplied to this instrument.

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 unsuitable, there is a risk of the internal circuits of the MS2650/MS2660 series being damaged by the abnormal voltage. Before supplying power again after changing the fuses, check that the protective grounding described previously is 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 rated voltage and current as the fuses in the fuse holders.

- If the replacement fuses are not of the same type, they may not fit correctly, there may be a faulty connection, or the time taken to for the fuses to blow may be too long.
- When an abnormality occurs again, if the voltage and current rating of the fuses is incorrect, the fuses may not blow with a consequent risk of damage to the equipment by fire.

This instrument with standard accessories has two spare 5 A fuses. The fuses are mounted 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.

After performing the safety procedures described on the preceding page, replace the fuses according to the following procedure.

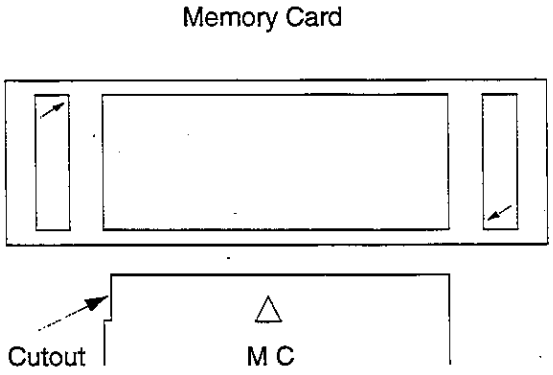
Step	Procedure
1	Set the front-panel [Power] switch to Stby and the rear-panel [Line] switch to OFF. Then, remove the power cord from the power-supply outlet.
2	Use a flat-bladed screwdriver to turn the fuse-holder cap counterclockwise. The cap and fuse are removed as a unit from the fuse holder.
3	Remove the fuse from the fuse cap and replace it with a spare fuse. (The direction does not matter.)
4	Return the fuse cap with fuse to the fuse holder and fasten it by turning it clockwise with the flat-bladed screwdriver.

Precaution for Handling Memory Card

See para. 1.3 for the memory card to be used.
When a new memory card used to save any file, format it beforehand to MS-DOS.
When saving data to a memory card; confirm that the write-protect switch of the card is set at the NOT-PROTECTED side, and then install it to this instrument. (For the setting method, see the operation manual of the card .)

- Installing Memory Card

  Install the memory card to this instrument, with the cutout of the card at the position as shown below. Two card can be installed at the upper and lower sides.



- Removing Memory Card

  Push the left eject button to remove the memory card at the upper side.
  Push the right eject button to remove the memory card at the lower side.

- Replacing Battery of Memory Card

  Memory card has a battery. When the battery life ends, the saved data is erased. Replace the battery before the life end. (For the battery life and replacing method, see the operation manual of the card.)

SECTION 3

PANEL DESCRIPTION

In this section, the front and rear panels are described about the case in which all the options are attached to.

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Table of Front and Rear Panel Features 3-3

SECTION 3
PANEL DESCRIPTION

In this section, the front and rear panels (Figs. 3-1 and 3-2) are described about the case in which all the options are attached to.

Table of Front and Rear Panel Features

No.	Panel Making	Explanation of Function
1	(LCD)	This is a 5.7 " color TFT liquid crystal display (LCD). It displays the trace waveforms, the parameter settings, the values of marker, and the soft menu keys, etc.
2	Menu On / Off	This toggles the soft-key menu display On / Off.
3	F 1 - F 6	These are the soft keys for selecting the soft-key menus linked to the panel key operation.
4	More	This displays the next page of soft-key menus.
5	Freq / Ampl	This is the frequency and level parameter data input section. [Frequency] Sets frequency. [Span] Sets frequency span. [Amplitude] Sets reference level. [–> CF] Sets peak level signal frequency on screen to center frequency. [–> RLV] Sets peak level on screen to reference level.
6	Marker	This section is related to operation of marker functions. [Marker] Sets marker. [Multi Mkr] Sets multimarkers. Press this key after pressing the [Shift] key. [Peak Search] Moves marker to currently-displayed peak level. [Marker –>] Sets parameter according to marker value. Press this key after pressing the [Shift] key.
7	User	This is a user-dedicated key which users can specify.

No.	Panel Making	Explanation of Function
8	Single	This sets the sweep mode. [Single] Executes single sweep. [Continuous] Executes continuous sweeping. Press this key after pressing the [Shift] key. The initial default is continuous sweeping.
9	Recall	This executes recall / save. [Recall] Reads measurement parameters and waveform data from internal memory or memory card. [Save] Saves measurement parameters and waveform data to internal memory or memory card.
10	Measure	This menu is for performing the various application measurements including frequency measurement, noise measurement, adjacent-channel leakage power measurement, etc.
11	TG	This sets the tracking generator function. (If Option 20 is not attached to, this key is not provided.)
12	Display	This section is for selecting the trace waveform. Normally, in the frequency domain, up to two trace waveforms can be displayed. The zero-span (Time Domain) mode is selected simply by pressing the [Time] key. [A, B] Displays trace A or B waveform in frequency domain. [A/B, A/BG] Displays trace A and B waveforms simultaneously, or displays trace A and BG (background frequency spectrum including trace A) simultaneously. [Time] Switches to zero span (Time domain) mode to display time domain waveforms. [A/Time] Displays trace A and the time domain waveform simultaneously.
13	Trig / Gate	This sets the trigger/gate and TV-image monitoring functions. [Trig/Gate] Sets the sweep-start trigger and gate(to control waveform-data write timing) functions. [TV Monitor] Sets the TV-image monitoring function.
14	Coupled Function	This sets the RBW, VBW, sweep time and input attenuator.

No.	Panel Making	Explanation of Function
15	Entry	These keys set the numeric data, units and special functions. [Rotary knob] Used for moving marker and inputting data. [∧ , ∨] Increments and decrements input data. [Shift] To execute panel functions indicated by blue letters, press this key and then press the blue-lettered key. [BS] Backspace key for correcting input mistakes. [0-9, . , +/–] Numeric-data setting keys. [GHz, MHz, kHz, Hz] Units keys for frequency, level, time, etc.
16	Preset	This sets the measurement parameters to the default values.
17	Local	This changes the remote status to the local status.
18	Copy	This outputs a hard copy of the screen to a printer or plotter.
19	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 for about 1 seconds. The equipment is returned to the Stby condition from the power-on condition when the key is pressed again for about 1 seconds.
20	Memory Card	This is the slot to set memory cards which save/load the waveform data and measurement parameters etc. Up to two plug-in memory card can be used. If Option 11 is not attached to, this is not provided.
21	RF Input	This is the RF input connector.
22	TG Output	This is the tracking generator output connector. (If Option 20 is not attached to, this connector is not provided.)
50	(Fan)	This is the cooling fan for ventilating internally-generated heat. Leave a clearance of at least 10 cm around the fan.
51	10 MHz STD	This is the input connector for an external reference crystal oscillator. When an external reference signal is input, the equipment switches automatically from the internal signal to the external signal. If Option 01 is not attached to, this connector is not provided.
52	IF OUT	This is the IF output connector. This signal is bandwidth controlled by the RBW setting and is logarithmically compressed at log scale.
53	Video (Y)	This connector output a Y-axis signal that is proportional to the video detection signal output.

No.	Panel Making	Explanation of Function
54	Composite Out	This is the video composite signal output connector.
55	Off / On	This is the AC line power switch.
56	(Inlet)	This is the fused AC power inlet to which the supplied power cord is connected. It contains two time-lag fuses.
57	(Ground Terminal)	Connect this frame ground terminal to ground to prevent risk of an accidental electric shock.
58	RS-232C	This is the RS-232C connector. Connect it to an external system controller or printer, etc.
59	GPIB or PARALLEL	This connector is for use with a GPIB (Option 09) or PARALLEL (Option 10) interface. It is connected to an external system controller, or a printer etc. (If no options are attached to, this connector is not provided.)
60	Trig/Gate In (±10 V)	This is a input connector for external trigger/gate signal. (If Option 06 is not attached to, this connector is not provided.)
61	Phone	This is a output connector for earphone. (If Option 07 is not attached to, this connector is not provided.)
62	Sweep (X)	This is a output connector for sweep signal (X). (If Option 15 is not attached to, this connector is not provided.)
63	Sweep Status (Z)	This is a output connector for sweep status signal (Z). (If Option 15 is not attached to, this connector is not provided.)

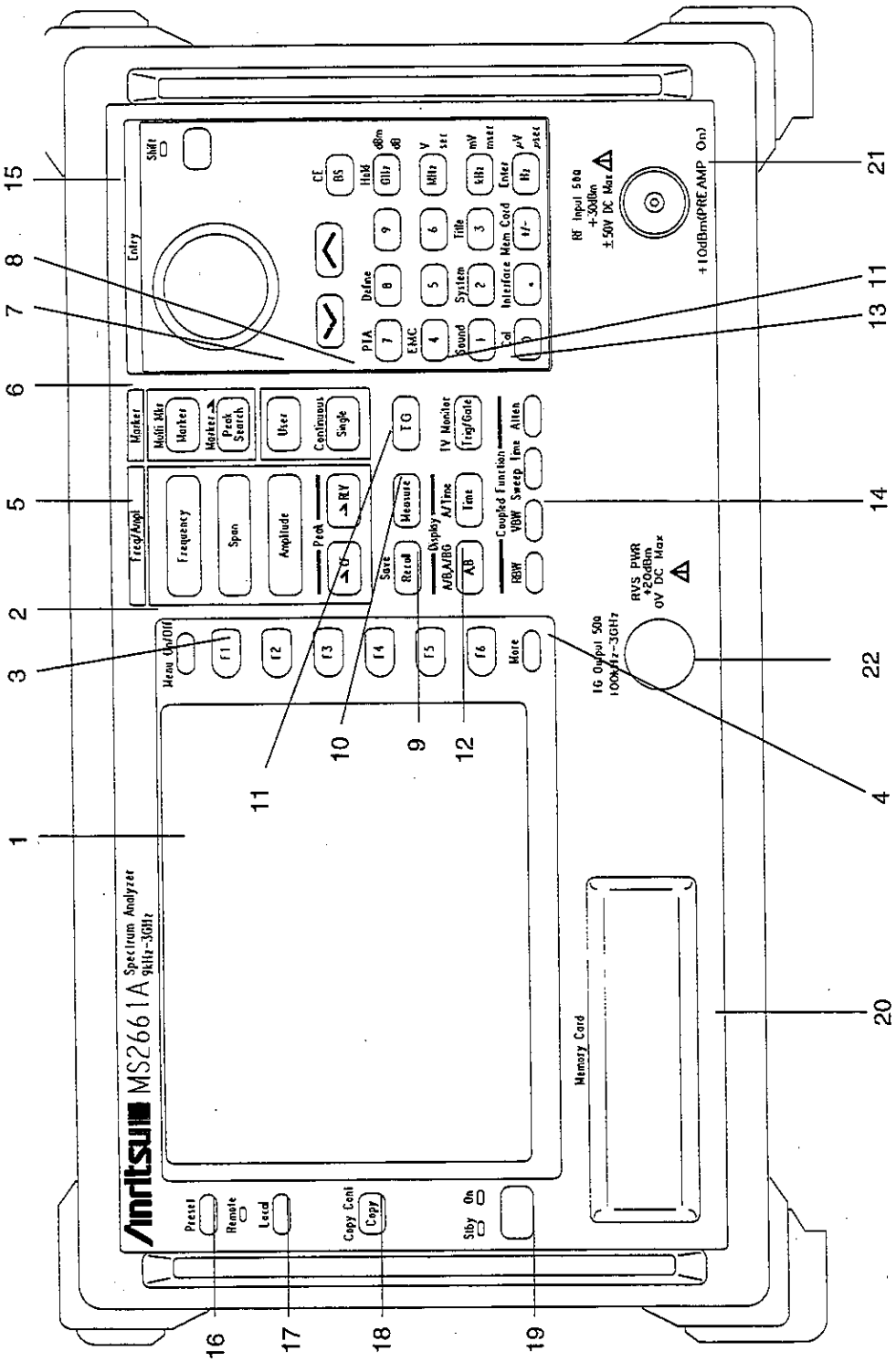

Fig. 3-1 Front Panel

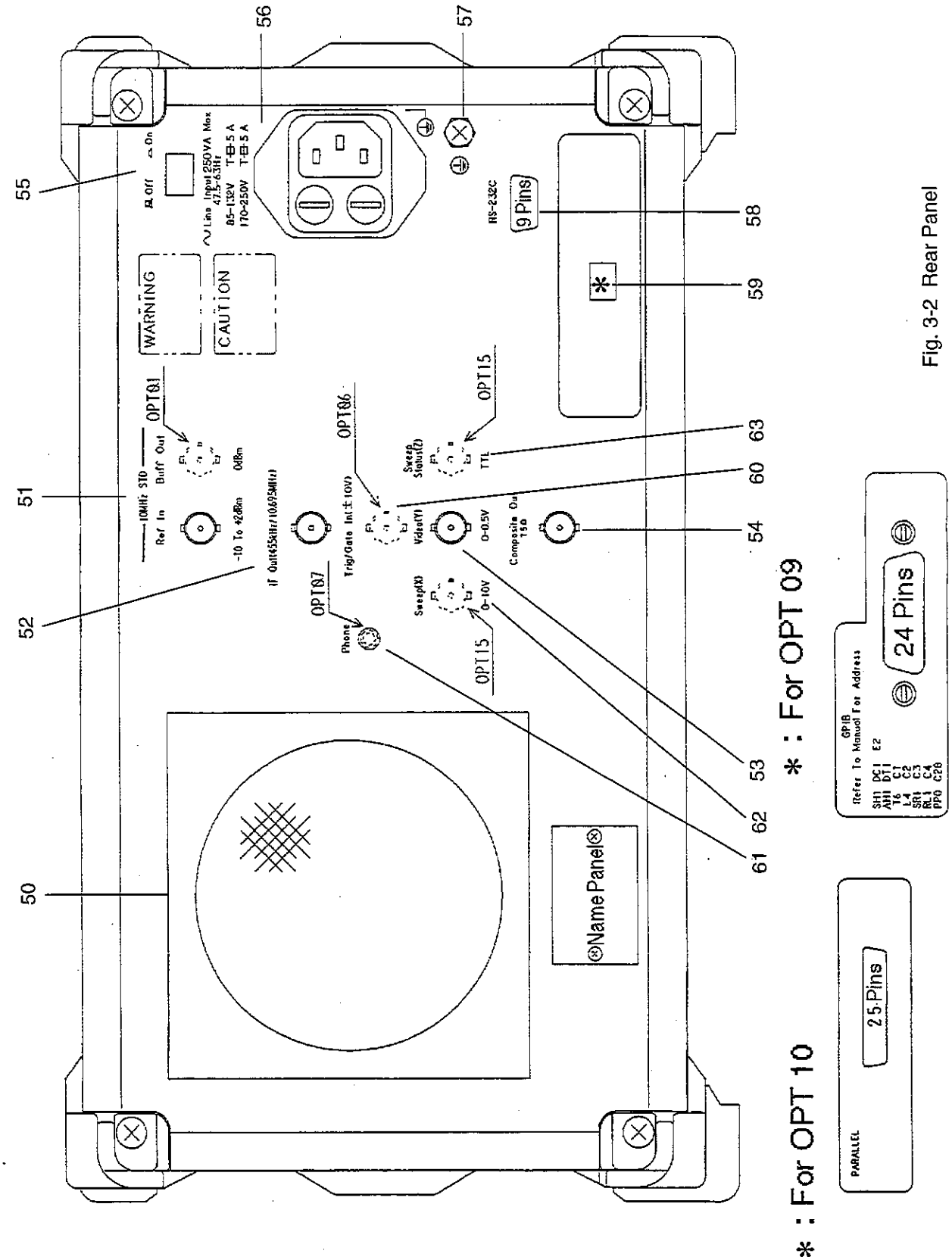

Fig. 3-2 Rear Panel

SECTION 4

SOFT-KEY MENU

In this section, soft-key menu functions and its hierarchical system are described using a tree.

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Soft-key Menu List 4-4

Menu Tree 4-6

SECTION 4
SOFT-KEY MENU

In this section, soft-key menu functions and its hierarchical system are described using a tree.
Matters to be noted about the tree are shown below.

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

(2) Top menus are the menus at the top level which are displayed on the screen when the panel key is pressed. Lower menus indicates other menus below the top menus.

(3) When a soft key with an appended asterisk (*) is pressed in these menus, the menu moves to the lower menu indicated by the arrow symbol (->). However, if any not-supported-function soft key in an Option is pressed, an error message is displayed.

(4) When the Return key is pressed at a lower menu, the next-higher menu is returned.

(5) Menus with more than six items are split into several pages.

(6) The menu page construction and currently-displayed page are indicated in the lower part of the menu. To move to the next page, press the [More] key.

(7) Panel keys and soft keys prefixed by a sharp symbol (#) at the left of the menu frame, give an outline explanation of the function.

Soft-key Menu List

Menu	Menu Tree (page/28)
A) A/B,A/BG	16
A/Time	17
ACP Setup1	8
ACP Setup2	8
ACP Setup3	8
Ajd ch Pwr	8
Amplitude	2
Attenuator	2 , 3
Avq Count	15
B) Burst Pwr	11
C) C/N Meas	7
Cal	22
Change Clr	21
Ch Power	7
Check File	26
Copy Cont	20
Copy from	21
Correction	2
CountSetup	7
D) Def Files	27
Def Menues	27
Define	27
Define Clr	21
Detection	15 , 17
Dip	5
Directory	25
Disp Line	2 , 4
Display	21
E) Edit Menu	27
Expand	17
F) File Ope	25
FM Monitor	17
Format	25
Freq Count	7
Frequency	1

Menu	Menu Tree (page/28)
G) Gate	18
Gate Setup	18
H) Hold Count	15
I) Impedance	2
Initialize	27
Interface	23
Item	12 , 20
L) Lib Exec	26
Lib File	26
Lib Memory	26
Lib Prgm	27
Lib Remove	26
Lin Scale	2
Line	9 , 10
Load/Save	9 , 10
Location	20
Log Scale	2
Lvl Offset	2
M) Manual Set	4
Marker	4
Marker->	4 , 5
Mask Meas	9
Measure	7
Media	25 , 27
Media	2 , 9 , 10
Mem Card	25
Mkr List	4
Move Mask	9
Move Temp	10
Multi Marker	4
N) Noise Meas	7
Normalize	14
O) OBW Setup	8
Occ BW	8

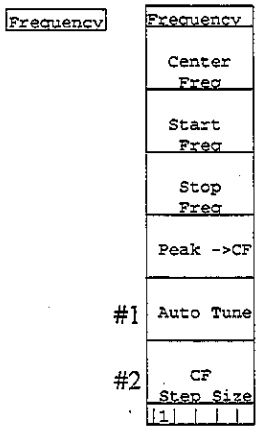
Menu	Menu Tree (page/28)
P) Paper Size	20
Peak	5
Plotter	20
Pon State	21
Pre Ampl	2
Preset	28
Preslctr	22
Printer	20
PTA	25
PTA Lib	26
Q) QP/EMC	24
R) RBW	3
Recal Media	12
Recall	12
Ref Line	15
Ref Step	2
RS232C	24
S) Save	13
Save Media	13 , 20
ScrollStep	1
Select	2 , 9 , 10
Set Date	21
Set Time	21
Setup	2
Setup Mask	9
Setup Temp	10
Souce	17 , 18
Sound	21
Span	1
Storage	15 , 17
Sweep Time	3
Swp Contl	16 , 17

Menu	Menu Tree (page/28)
System	21
T) Temp Meas	10
TG	14
Threshold	5
Title	24
Trace A,B	14 , 15
Trace Calc	15
Trace Move	15
Trace Time	17 , 18
TrackingAd	14
Trnsformer	2
Trig Ext	18
Trig TV	18
Trig Video	18
Trigger	18
TV Monitor	19
U) Units	2
User1	6
User2	6
User3	6
V) VBW	3
W) Wide IF	18
Z) Zone Width	4

Menu Tree

Menu Tree (1 /28)

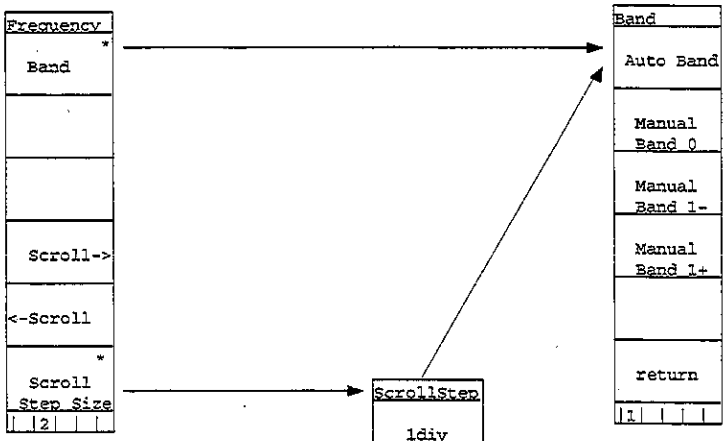
— Panel Key —+— Top menu —————+— Lower menues ————————————————

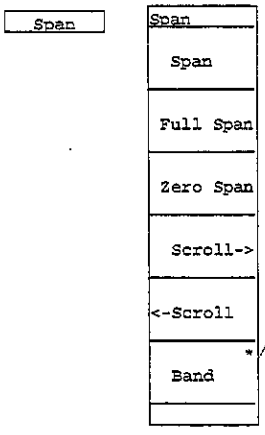


- Set items related to frequency, including the center frequency, start/stop frequency, peak->CF, auto synchronization, frequency scroll step size and scroll step size, etc.

#1 Detects peak point in pre-specified (in BG range) span and automatically tunes the peak signal to the specified span.

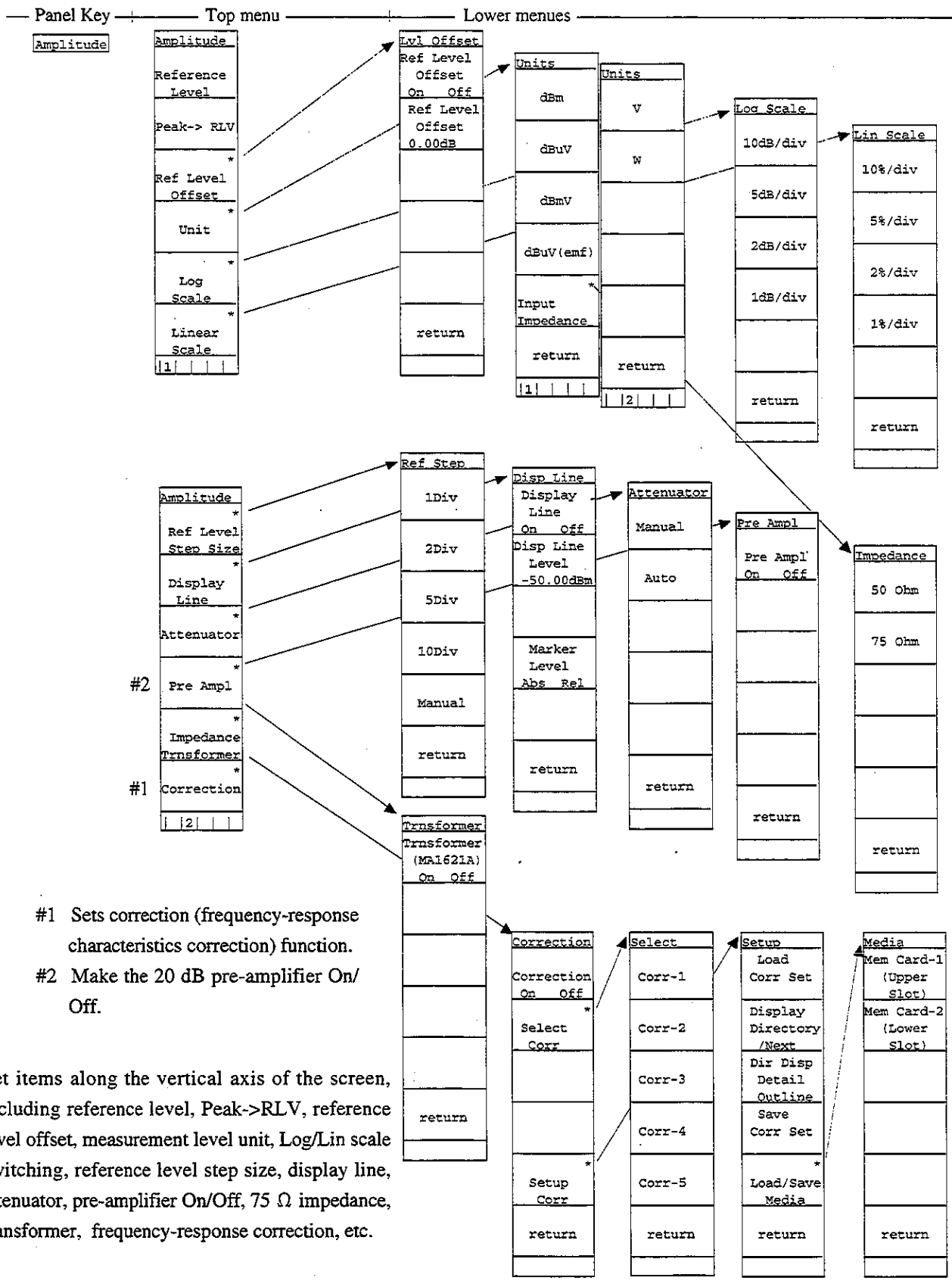
#2 Sets frequency step size for changing center frequency.





- Set frequency span items, including frequency span, full span, zero span, frequency span scroll, etc.

Menu Tree (2/28)



#1 Sets correction (frequency-response characteristics correction) function.

#2 Make the 20 dB pre-amplifier On/ Off.

- Set items along the vertical axis of the screen, including reference level, Peak->RLV, reference level offset, measurement level unit, Log/Lin scale switching, reference level step size, display line, attenuator, pre-amplifier On/Off, 75 Ω impedance, transformer, frequency-response correction, etc.

Menu Tree (3/28)

Panel Key — Top menu — Lower menues

RBW

RBW
Manual
Auto
RB,VB,SWT Auto
#1 All Auto

- Set the manual/auto of resolution bandwidth, and auto (RBW, VBW and SWP only) or all auto.

#1 Sets RBW, VBW, Sweep Time, Atten all to Auto.

VBW

VBW
Manual
Auto
Filter Off
#2 VB/RB Ratio 1.0
RB,VB,SWT Auto
All Auto

- Set the manual/auto of video bandwidth, and auto(RBW, VBW and SWP only) or all auto.

#2 Sets ratio of VBW to RBW when VBW is Auto.

Sweep Time

Sweep Time
Manual
Auto
RB,VB,SWT Auto
All Auto

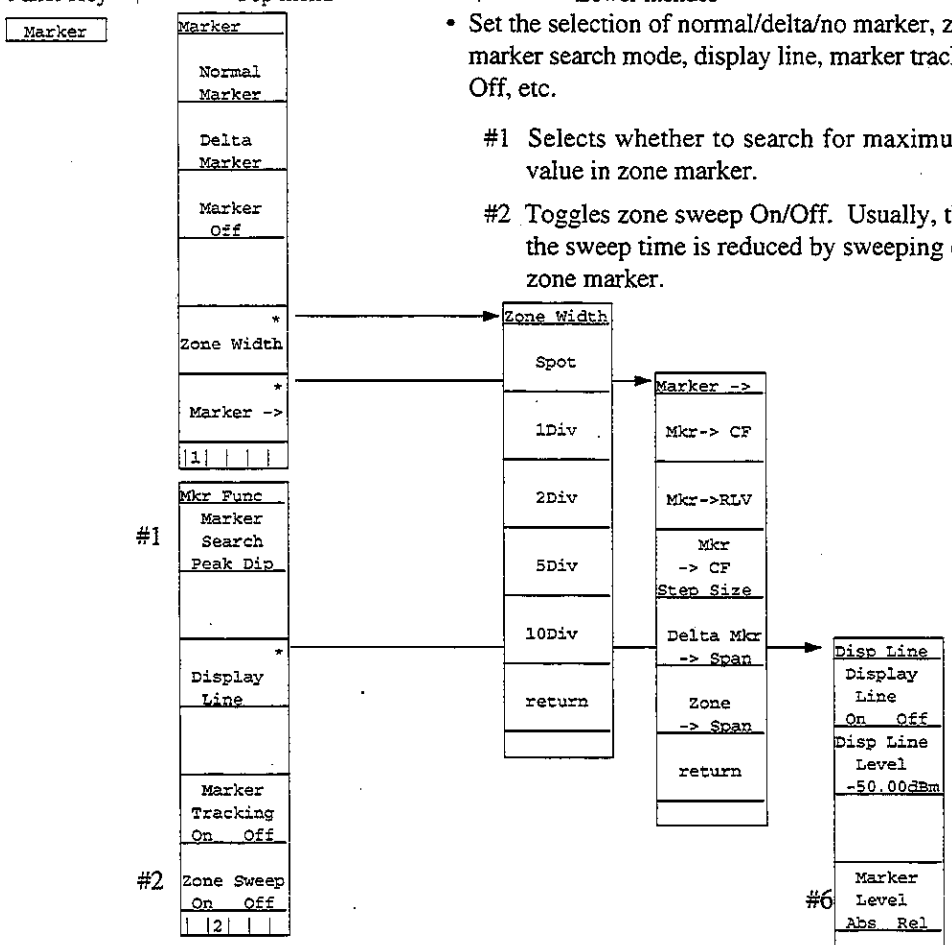
- Set the manual/auto of sweep time, and auto (RBW, VBW and SWP only) or all auto.

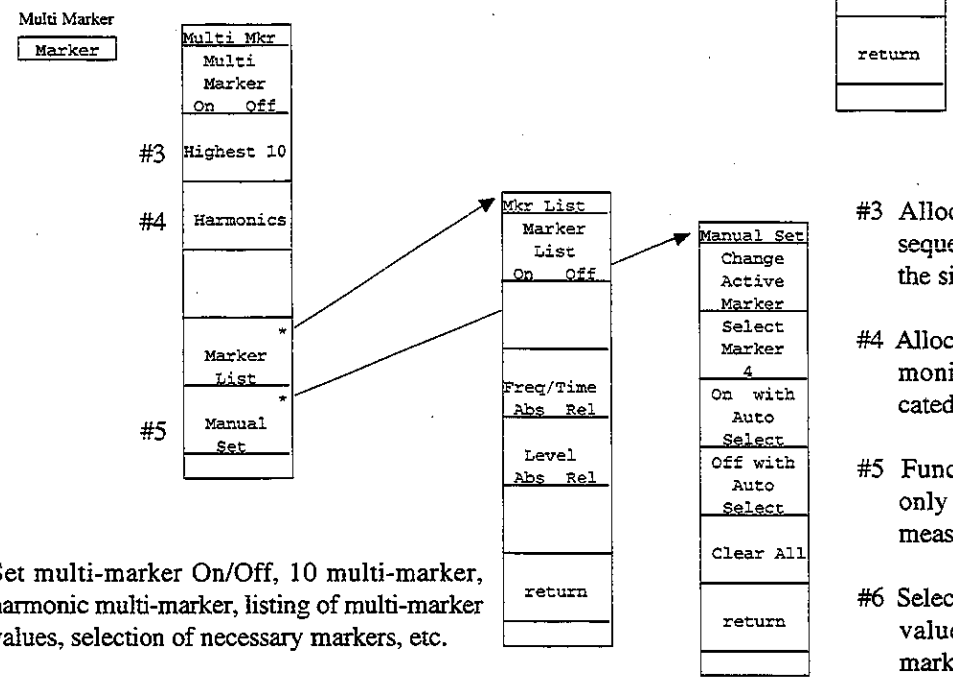
Atten

Attenuator
Manual
Auto
Pre Ampl On Off
All Auto

- Set the manual/auto of the input attenuator, On/Off of the pre-amplifier and all auto.

Menu Tree (4/28)





- Set the selection of normal/delta/no marker, zone marker width, marker->, marker search mode, display line, marker tracking On/Off, zone sweep On/Off, etc.

  #1 Selects whether to search for maximum (Peak) or minimum (Dip) value in zone marker.

  #2 Toggles zone sweep On/Off. Usually, the zone sweep is Off. At On, the sweep time is reduced by sweeping only the zone specified by the zone marker.

- Set multi-marker On/Off, 10 multi-marker, harmonic multi-marker, listing of multi-marker values, selection of necessary markers, etc.

#3 Allocates up to 10 multi-markers sequentially from the peak level of the signal displayed on screen.

#4 Allocates multi-markers to the harmonic signals of frequency indicated by current marker.

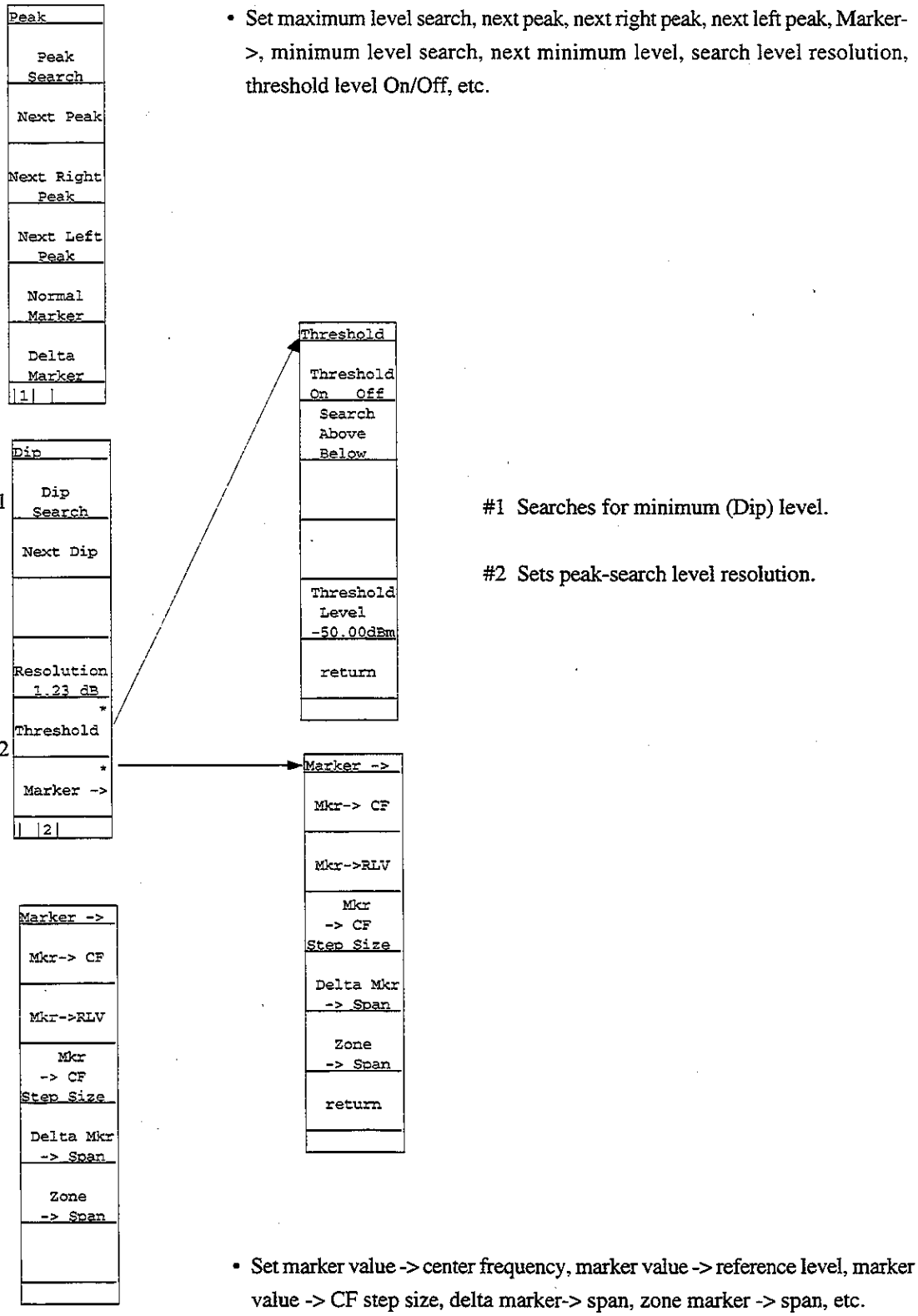
#5 Function allowing user to select only multi-markers necessary for measurement.

#6 Select "absolute value" or "relative value (display line)" to display marker level.

Menu Tree (5 /28)

— Panel Key — Top menu — Lower menues —

Peak Search



- Set maximum level search, next peak, next right peak, next left peak, Marker->, minimum level search, next minimum level, search level resolution, threshold level On/Off, etc.

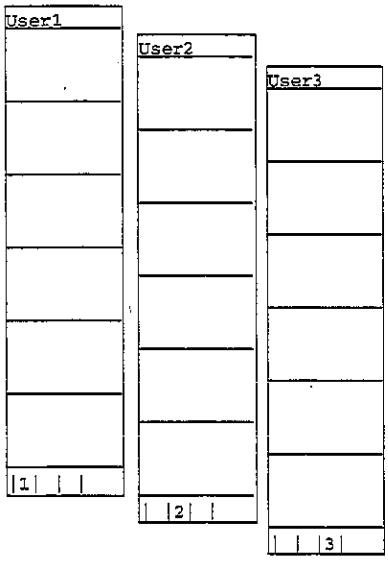
#1 Searches for minimum (Dip) level.

#2 Sets peak-search level resolution.

- Set marker value -> center frequency, marker value -> reference level, marker value -> CF step size, delta marker-> span, zone marker -> span, etc.

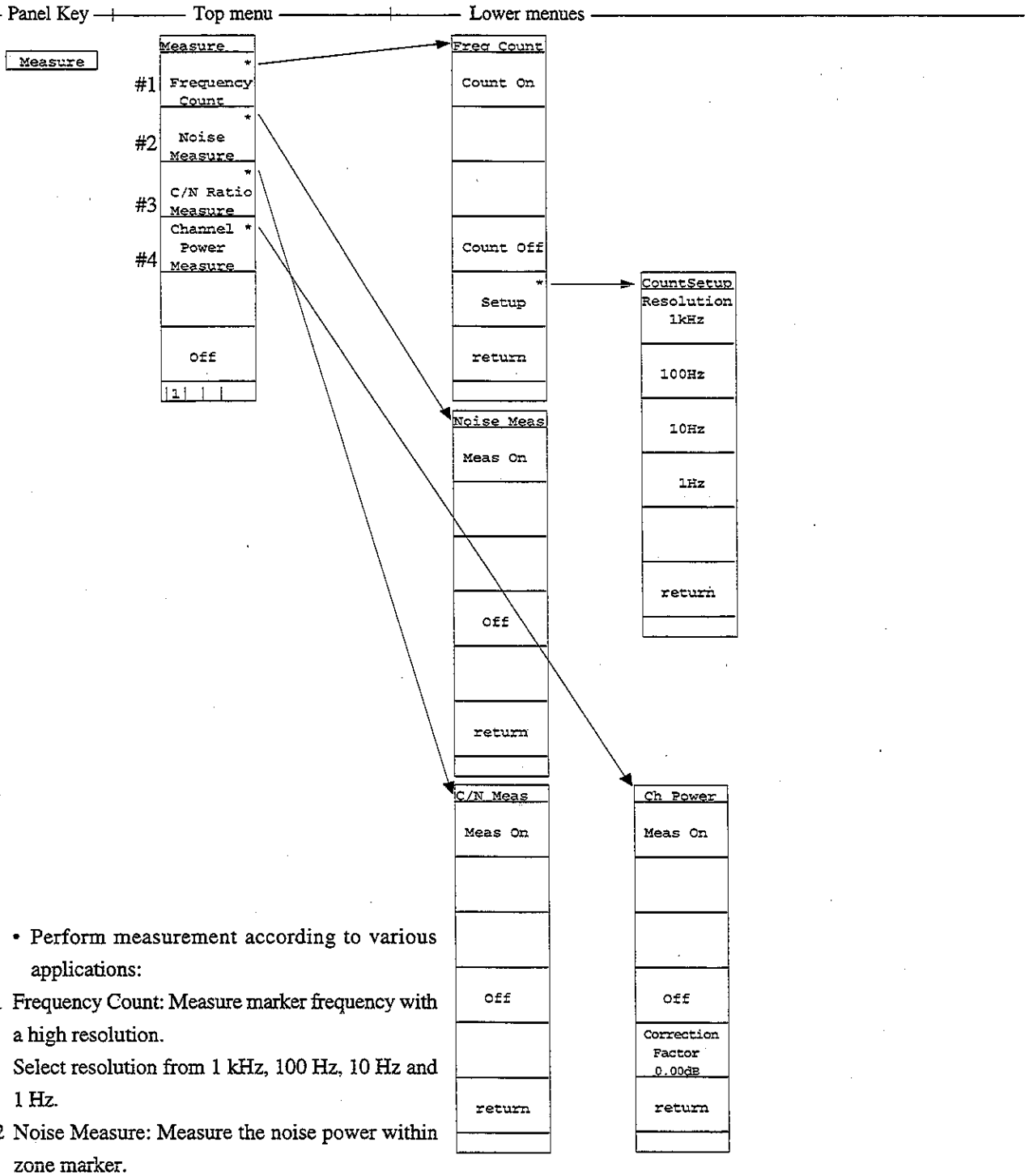
Menu Tree (6/28)

Panel Key	Top menu	Lower menues
Peak →CF		
Peak →RLV		
Single		
Continuous Single		
User	User1 User2 User3	



- The soft-key menu defined by the user is displayed. (See "User Define".)

Menu Tree (7/28)



- Perform measurement according to various applications:

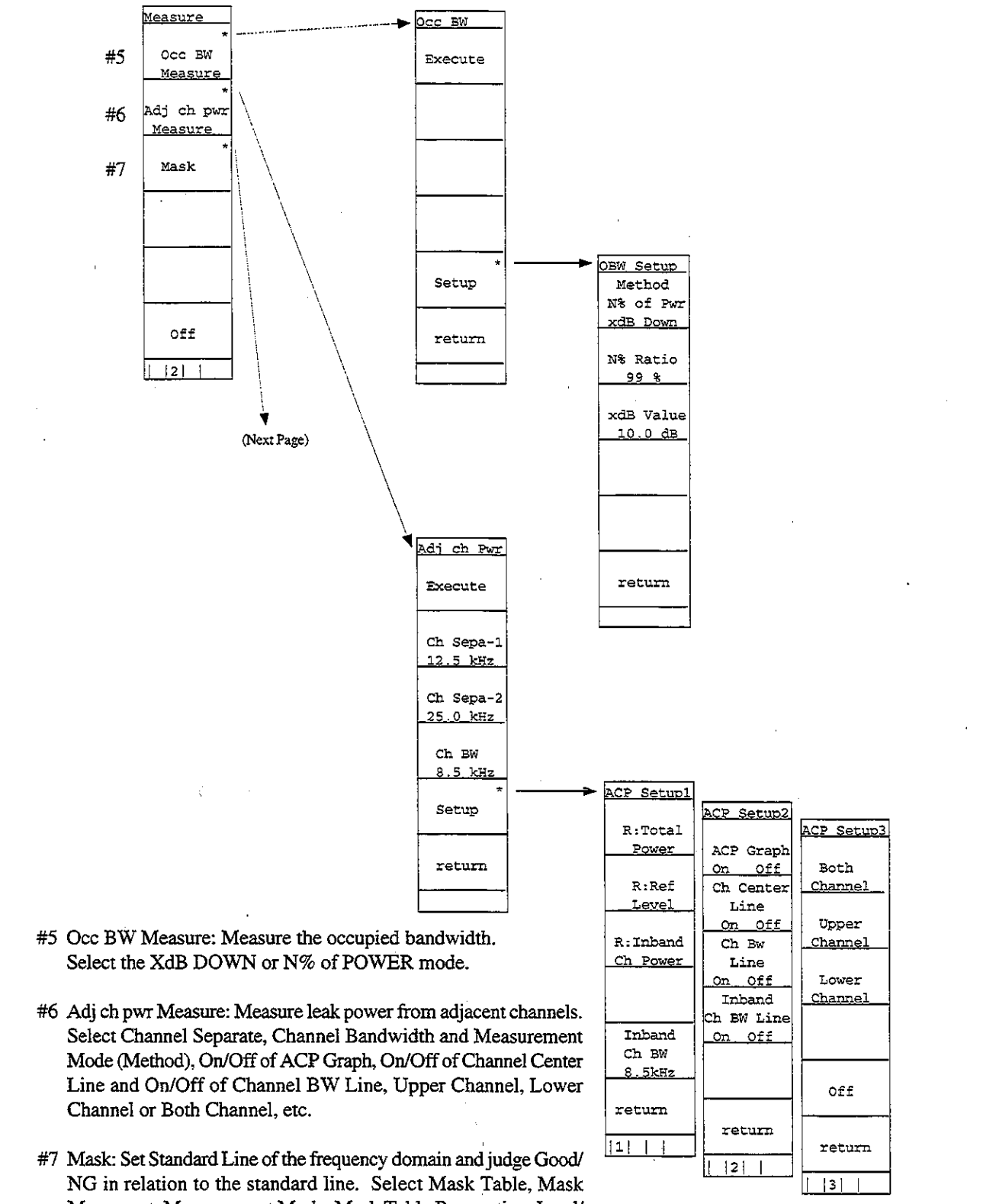
#1 Frequency Count: Measure marker frequency with a high resolution.
Select resolution from 1 kHz, 100 Hz, 10 Hz and 1 Hz.

#2 Noise Measure: Measure the noise power within zone marker.

#3 C/N Ratio Measure: Measure the ratio of carrier signal and noise power. Reference marker of the delta marker shall be set to the carrier, and marker's zone width specifies the power measured.

#4 Channel Power Measure: Power with in the band indicated by zone maker is measured. It is possible to set an arbitrary calibration value.

Menu Tree (8/28)

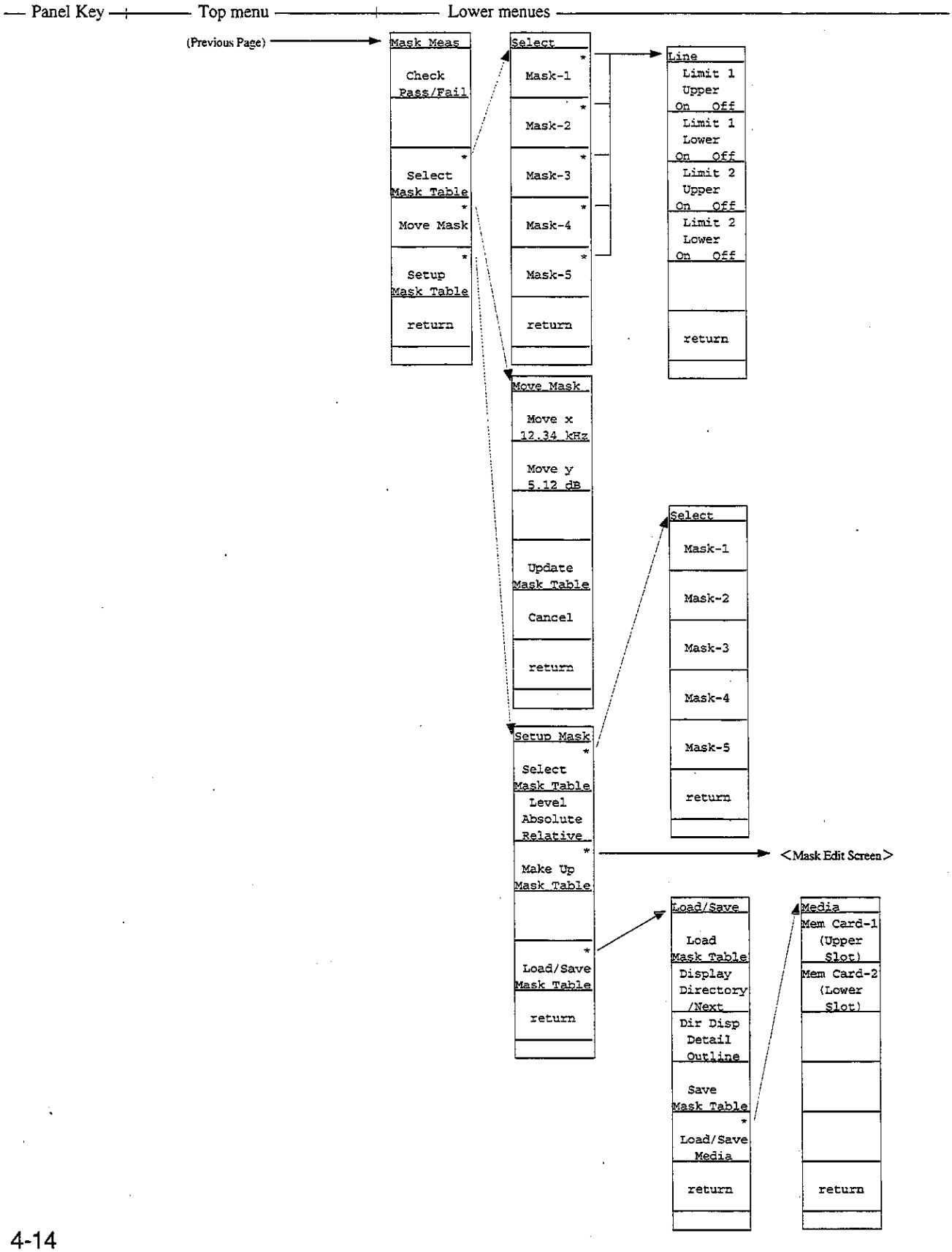


#5 Occ BW Measure: Measure the occupied bandwidth. Select the XdB DOWN or N% of POWER mode.

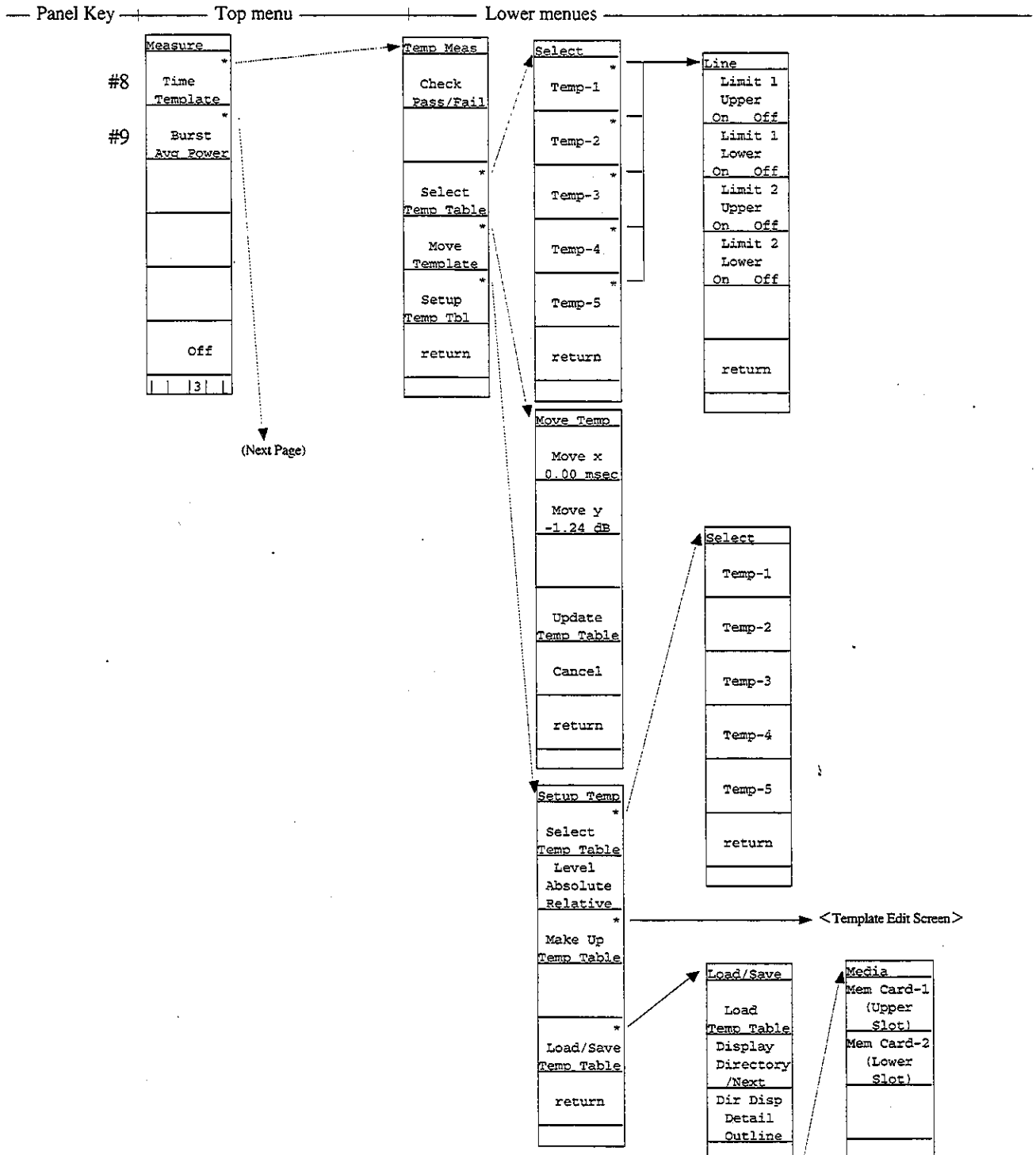
#6 Adj ch pwr Measure: Measure leak power from adjacent channels. Select Channel Separate, Channel Bandwidth and Measurement Mode (Method), On/Off of ACP Graph, On/Off of Channel Center Line and On/Off of Channel BW Line, Upper Channel, Lower Channel or Both Channel, etc.

#7 Mask: Set Standard Line of the frequency domain and judge Good/ NG in relation to the standard line. Select Mask Table, Mask Movement, Measurement Mode, Mask Table Preparation, Load/ Save of Mask Table, etc.

Menu Tree (9/28)



Menu Tree (10/28)



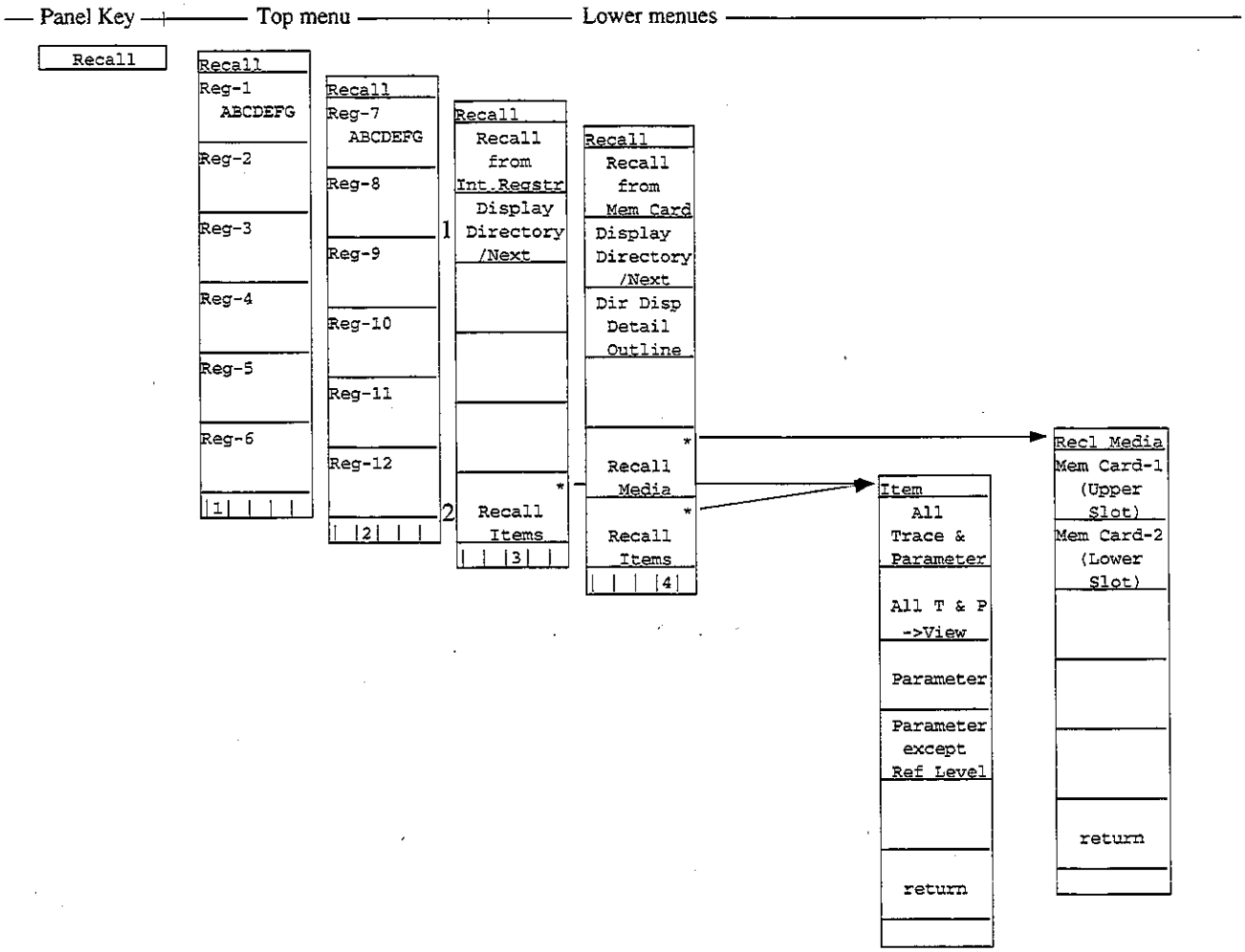
#8 Time Template: Set Standard Line of the time domain and judge Good/NG in relation to the standard line. Select Template Table, Template Movement, Measurement Mode, Template Table Preparation, Load/Save of Mask Table, etc.

#9 Burst Avg Power: Measure the mean power of burst signals in the time domain. Select the start/end points.

Menu Tree (11/28)

Panel Key	Top menu	Lower menues
(Previous Page)	Burst Pwr	
	Execute	
	Start Point 100	
	Stop Point 100	
	return	

Menu Tree (12/28)

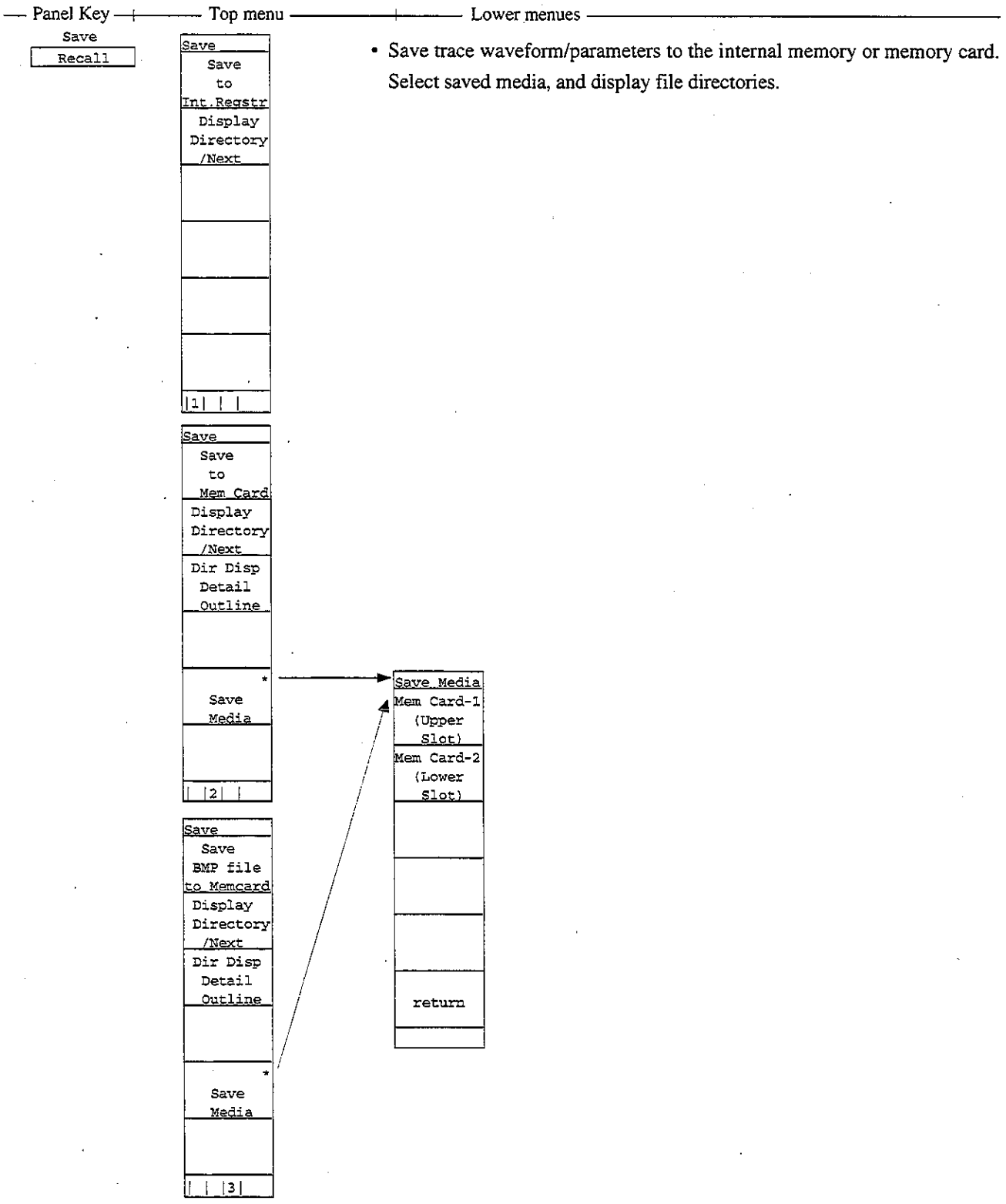


- Read out trace waveform/parameters from the internal memory or memory card. Select recall addresses and media/items, and display file directories.

  #1 Displays list of internal-memory directories.

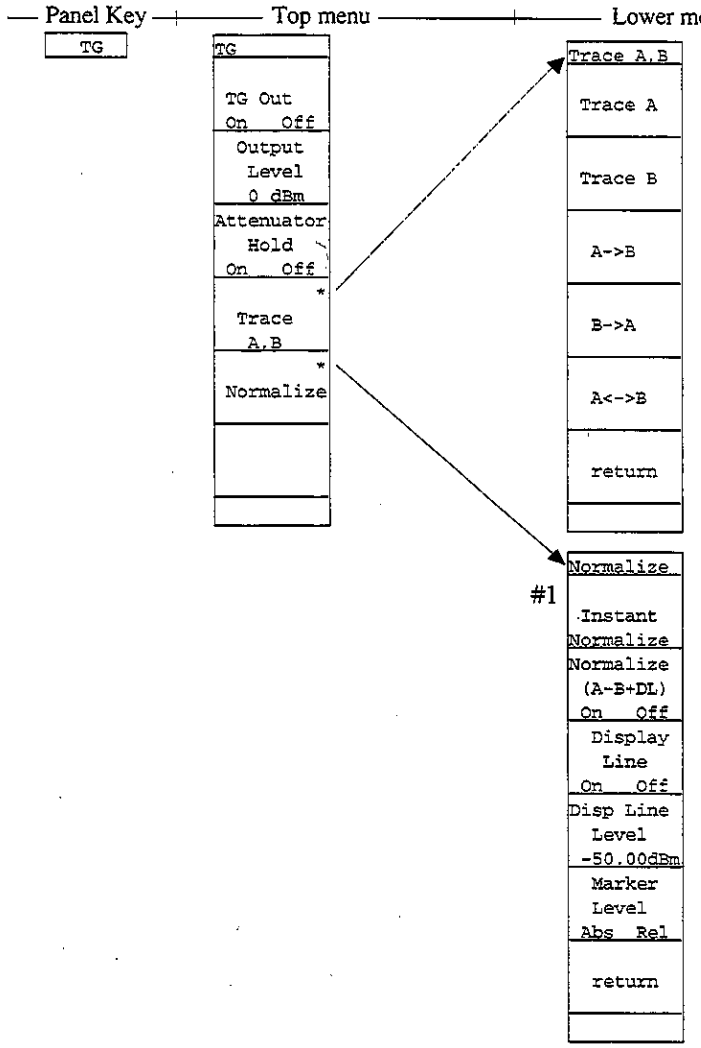
  #2 Specifies items to be recalled (trace waveform, parameter, etc.).

Menu Tree (13/28)



- Save trace waveform/parameters to the internal memory or memory card. Select saved media, and display file directories.

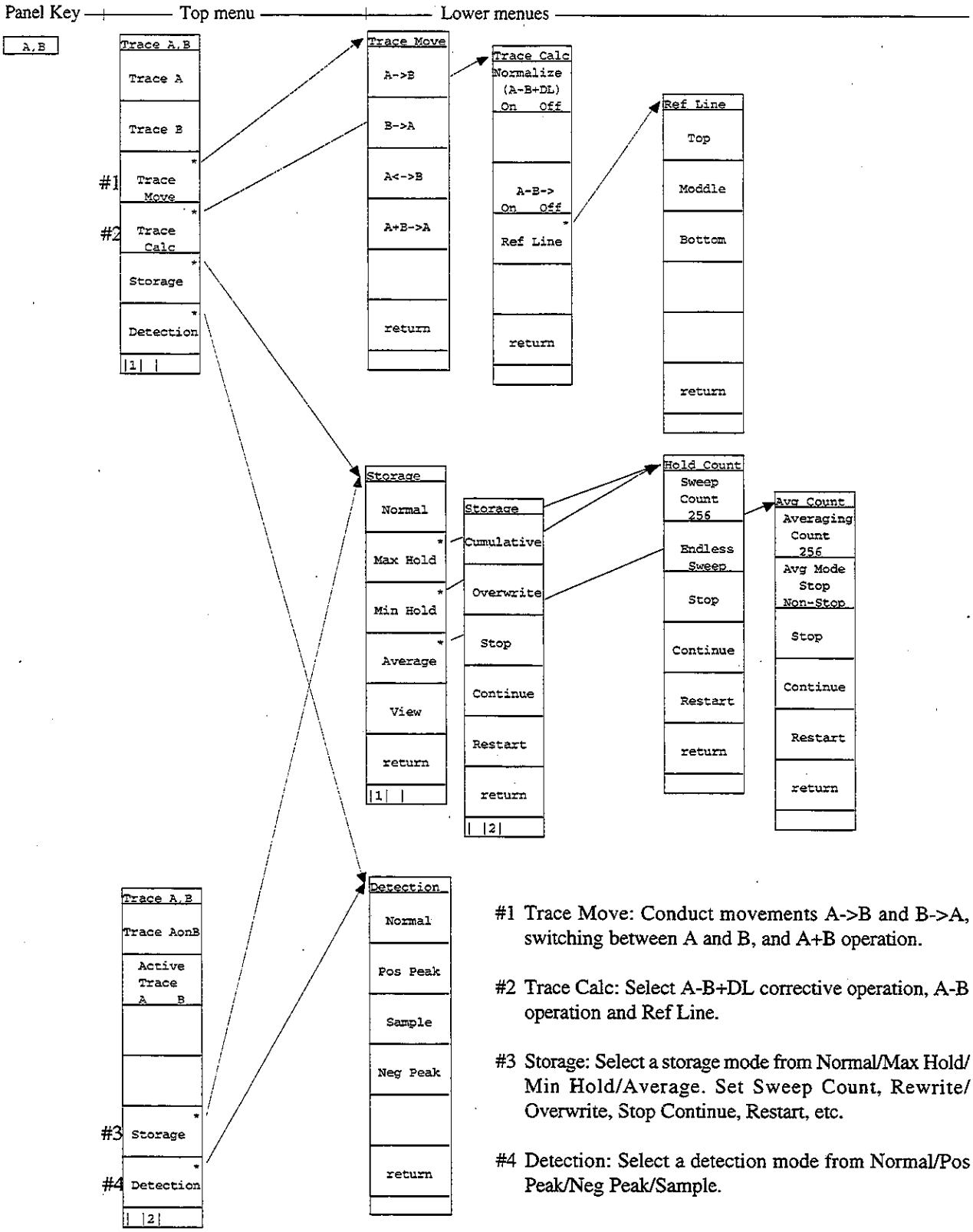
Menu Tree (14/28)



- Set ON/OFF and output level of tracking generator.

#1 Normalize trace-A waveform data, and display it.

Menu Tree (15/28)



#1 Trace Move: Conduct movements A->B and B->A, switching between A and B, and A+B operation.

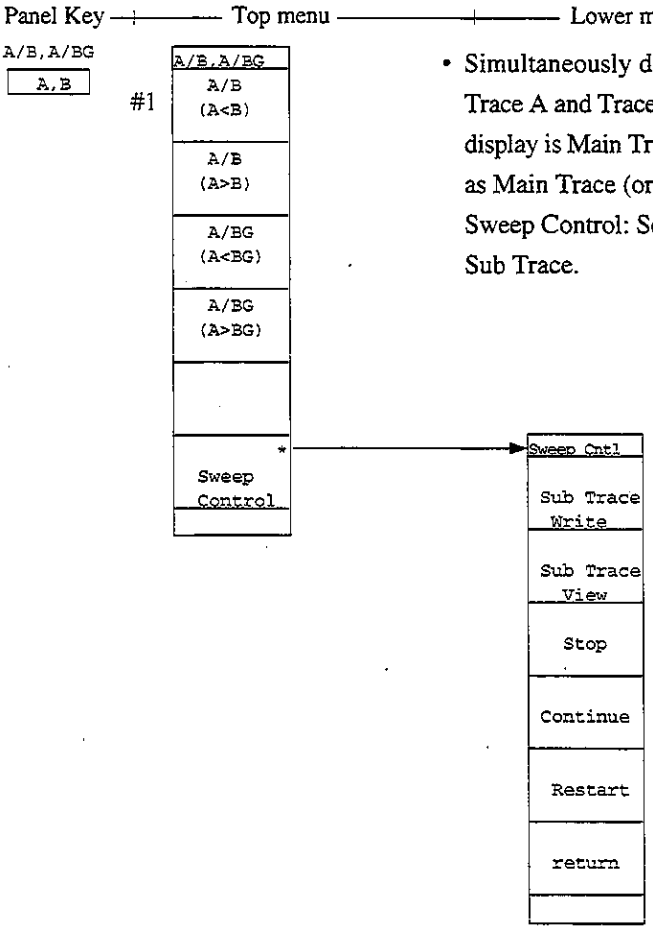
#2 Trace Calc: Select A-B+DL corrective operation, A-B operation and Ref Line.

#3 Storage: Select a storage mode from Normal/Max Hold/ Min Hold/Average. Set Sweep Count, Rewrite/ Overwrite, Stop Continue, Restart, etc.

#4 Detection: Select a detection mode from Normal/Pos Peak/Neg Peak/Sample.

- Select Trace A/B, movement between Trace A/B, sum/difference operation between Trace A/B and Ref Line, and designate the storage and detection modes and Active Trace.

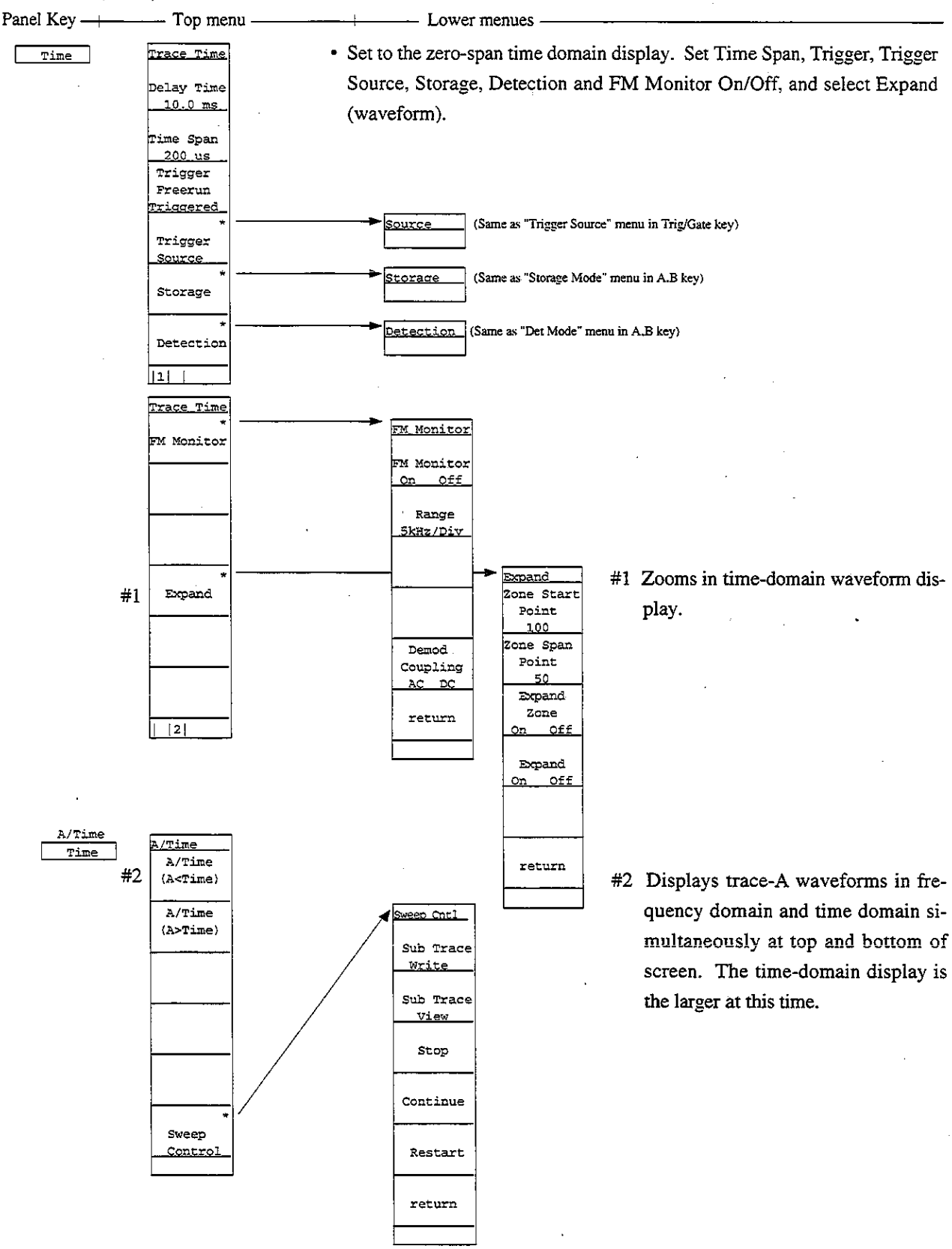
Menu Tree (16/28)



- Simultaneously display two waveforms, namely Trace A and Trace B or Trace A and Trace BG (peripheral spectrum containing Trace A). The large display is Main Trace and the small one is Sub Trace; select which to display as Main Trace (or Sub Trace).
  Sweep Control: Set Stop/Continuous/Restart for sweep and Stop/Write for Sub Trace.

#1 Displays two traces A and B simultaneously at top and bottom of screen. The trace-B display is the larger at this time.

Menu Tree (17/28)



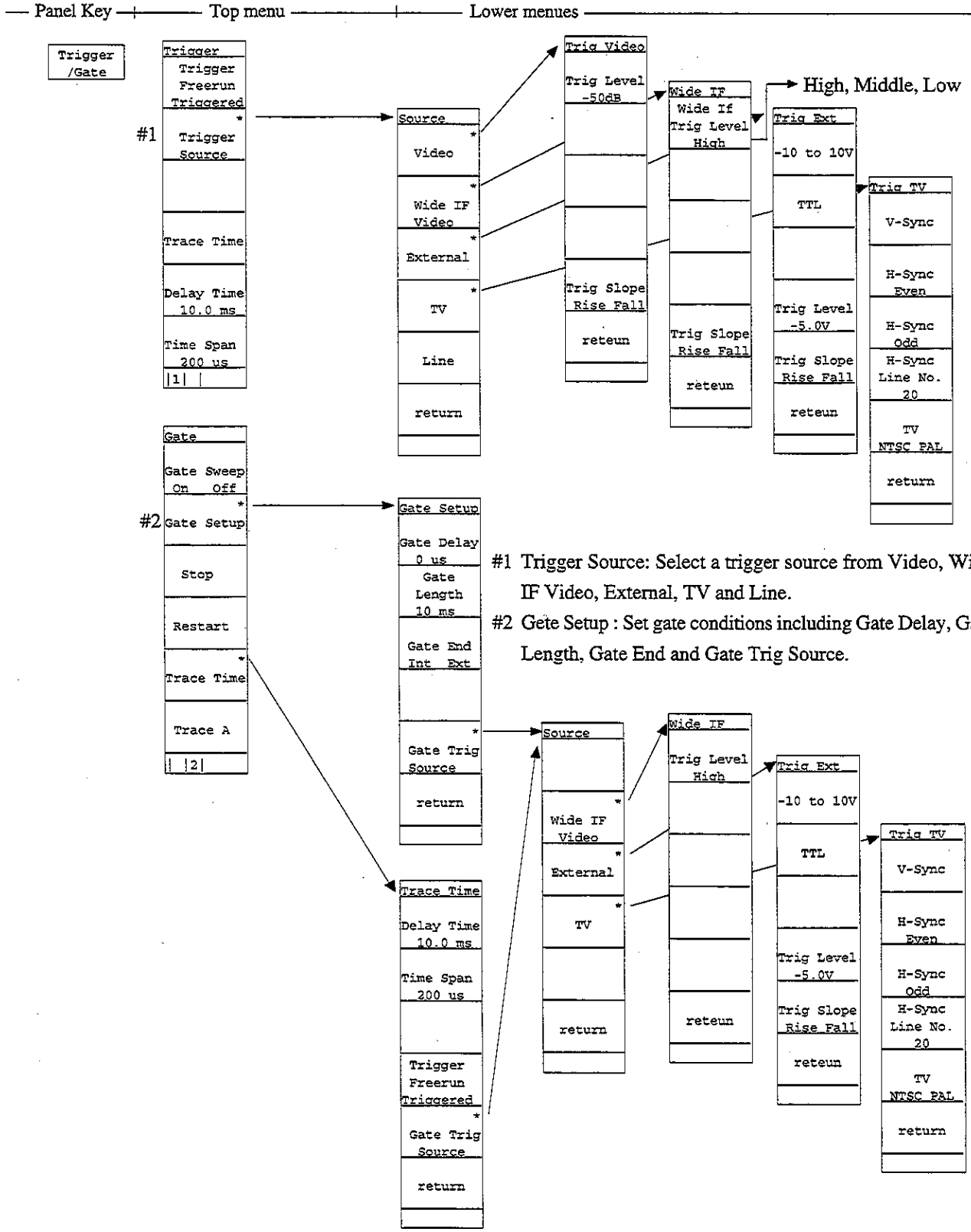
- Set to the zero-span time domain display. Set Time Span, Trigger, Trigger Source, Storage, Detection and FM Monitor On/Off, and select Expand (waveform).

#1 Zooms in time-domain waveform display.

#2 Displays trace-A waveforms in frequency domain and time domain simultaneously at top and bottom of screen. The time-domain display is the larger at this time.

- Simultaneously display waveforms of Trace a and Time Domain. Which to display as Main Trace (or Sub Trace) can be selected.

Menu Tree (18/28)

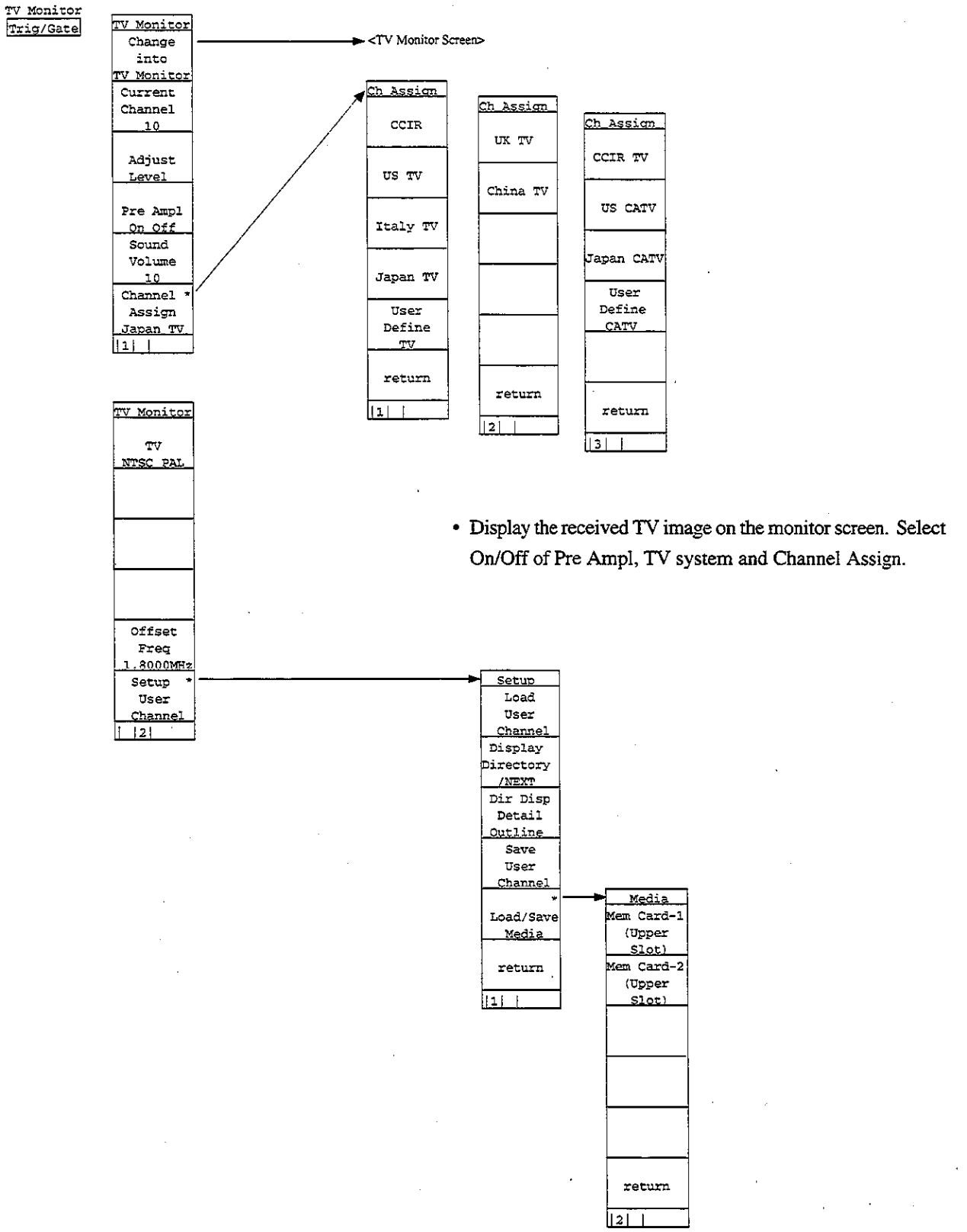


#1 Trigger Source: Select a trigger source from Video, Wide IF Video, External, TV and Line.

#2 Gete Setup : Set gate conditions including Gate Delay, Gate Length, Gate End and Gate Trig Source.

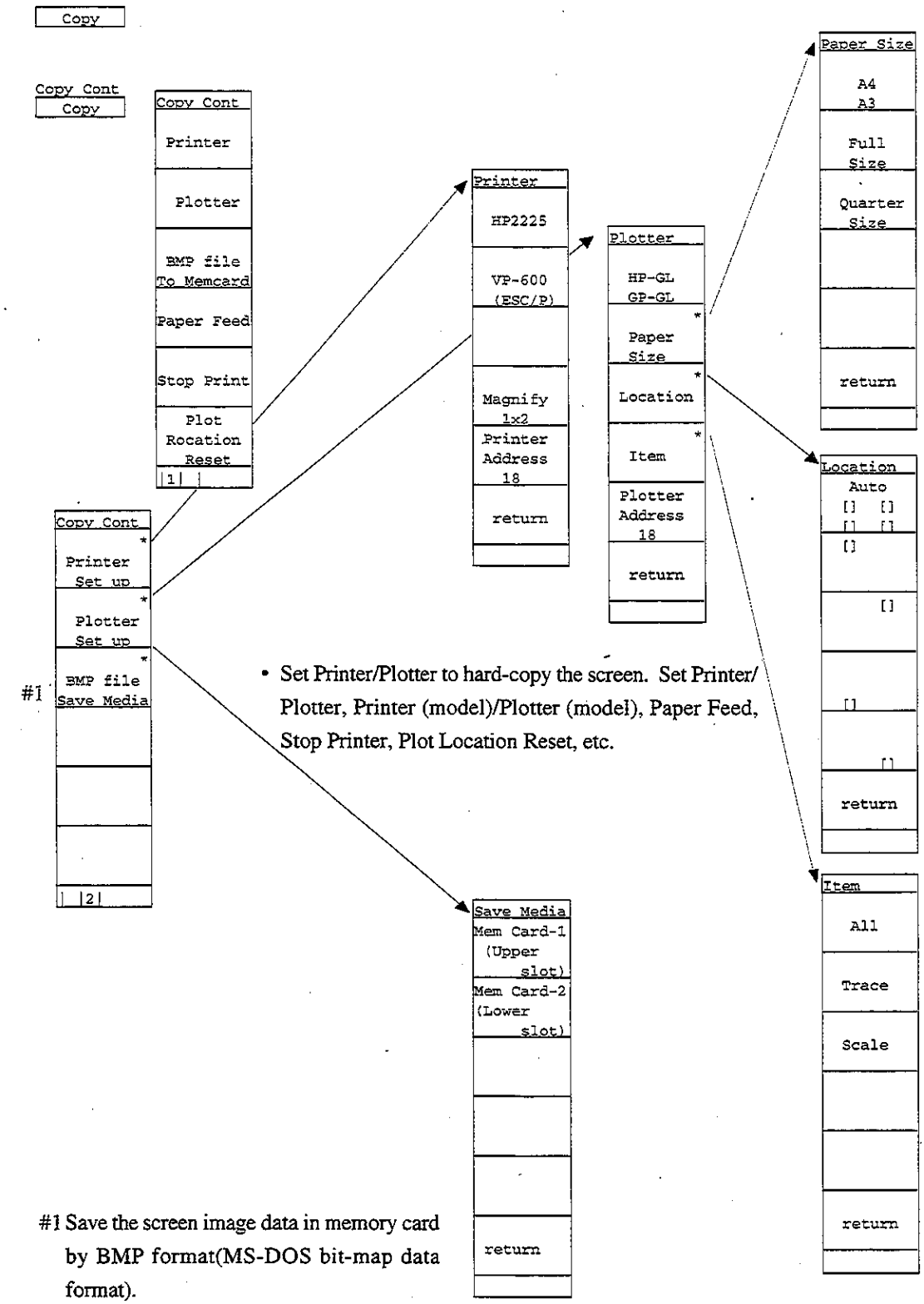
- Set gate functions for controlling the sweep start trigger and the writing of waveform data. Set the trigger mode, trigger source, trace time, delay time and time span. Select On/Off, Stop and Restart of Gate Sweep.

Menu Tree (19/28)



- Display the received TV image on the monitor screen. Select On/Off of Pre Ampl, TV system and Channel Assign.

Menu Tree (20/28)

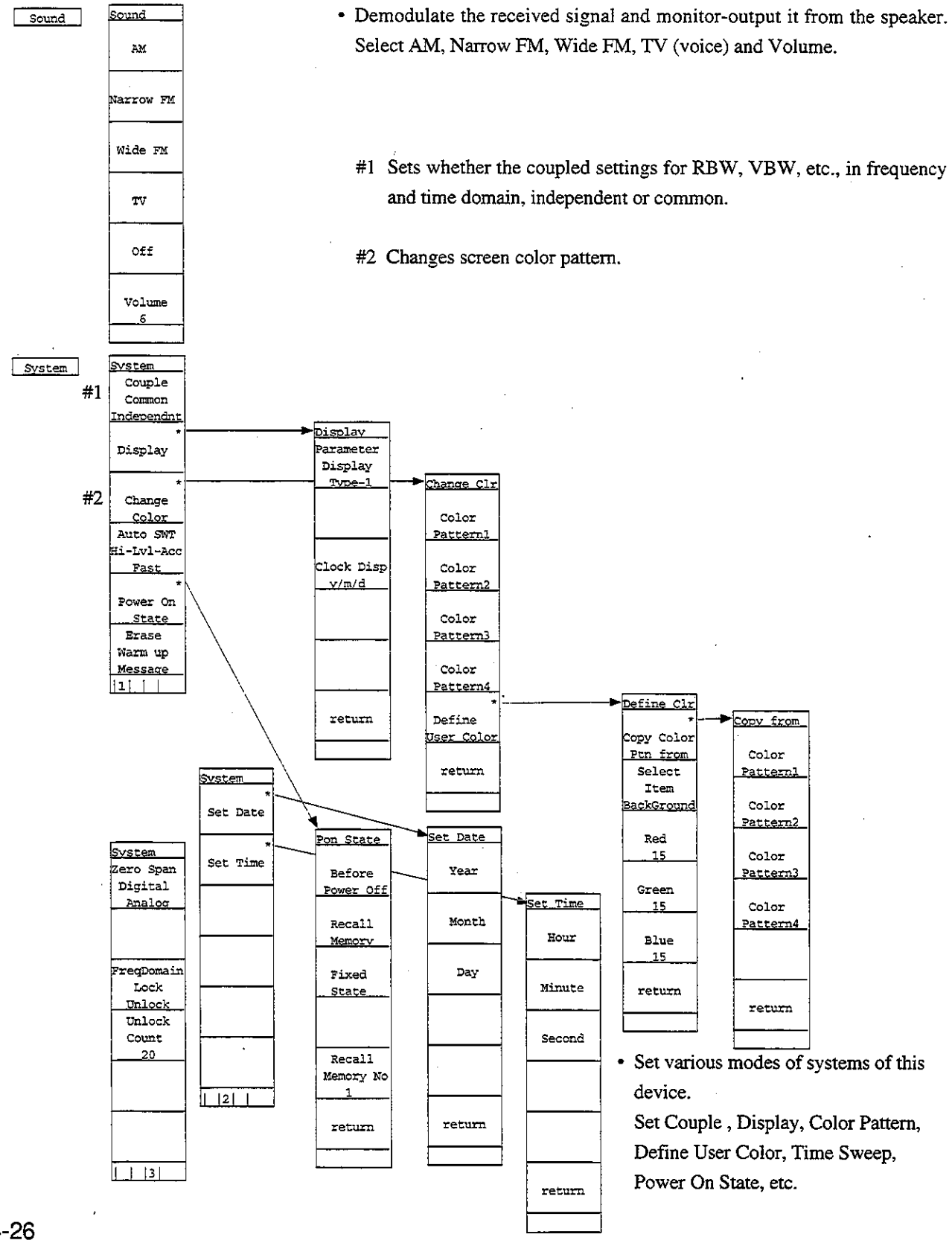


- Set Printer/Plotter to hard-copy the screen. Set Printer/Plotter, Printer (model)/Plotter (model), Paper Feed, Stop Printer, Plot Location Reset, etc.

#1 Save the screen image data in memory card by BMP format(MS-DOS bit-map data format).

Menu Tree (21/28)

Panel Key — Top menu — Lower menues



- Demodulate the received signal and monitor-output it from the speaker. Select AM, Narrow FM, Wide FM, TV (voice) and Volume.

#1 Sets whether the coupled settings for RBW, VBW, etc., in frequency and time domain, independent or common.

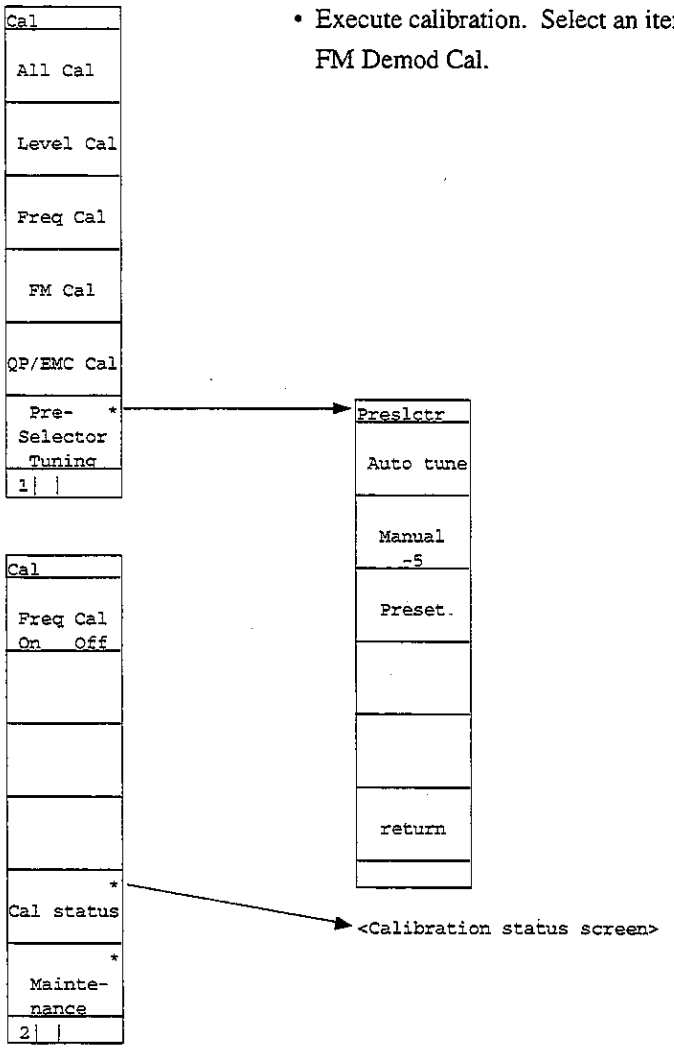
#2 Changes screen color pattern.

- Set various modes of systems of this device.
  Set Couple , Display, Color Pattern, Define User Color, Time Sweep, Power On State, etc.

Menu Tree (22/28)

Panel Key — Top menu — Lower menues

Cal

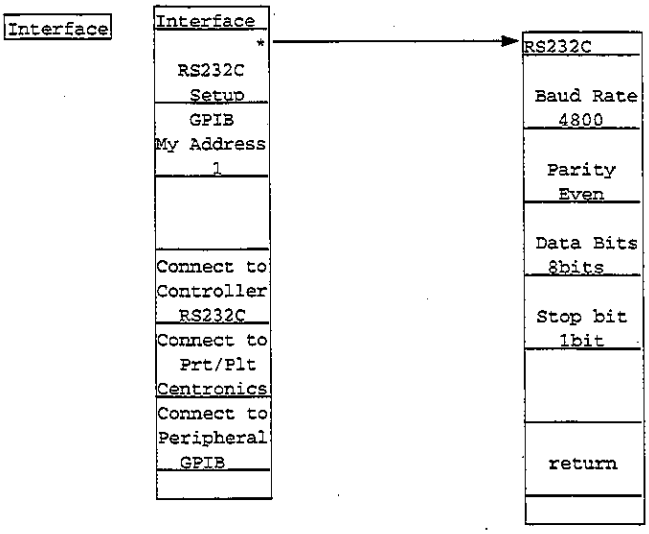


- Execute calibration. Select an item from All Cal, Level Cal, Freq Cal, and FM Demod Cal.

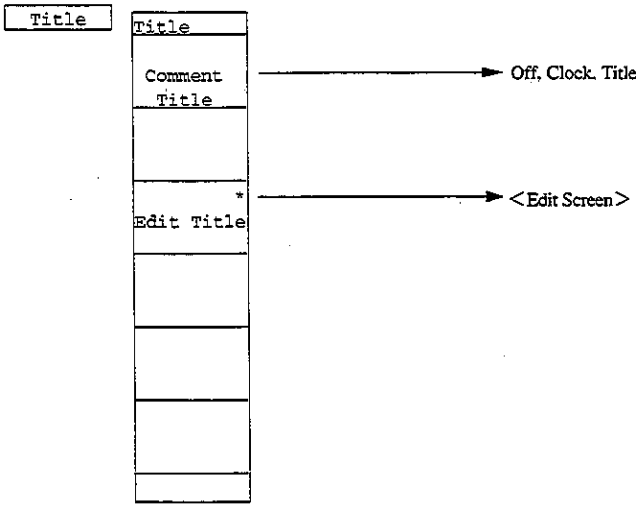
Menu Tree (23/28)

Panel Key — Top menu — Lower menues

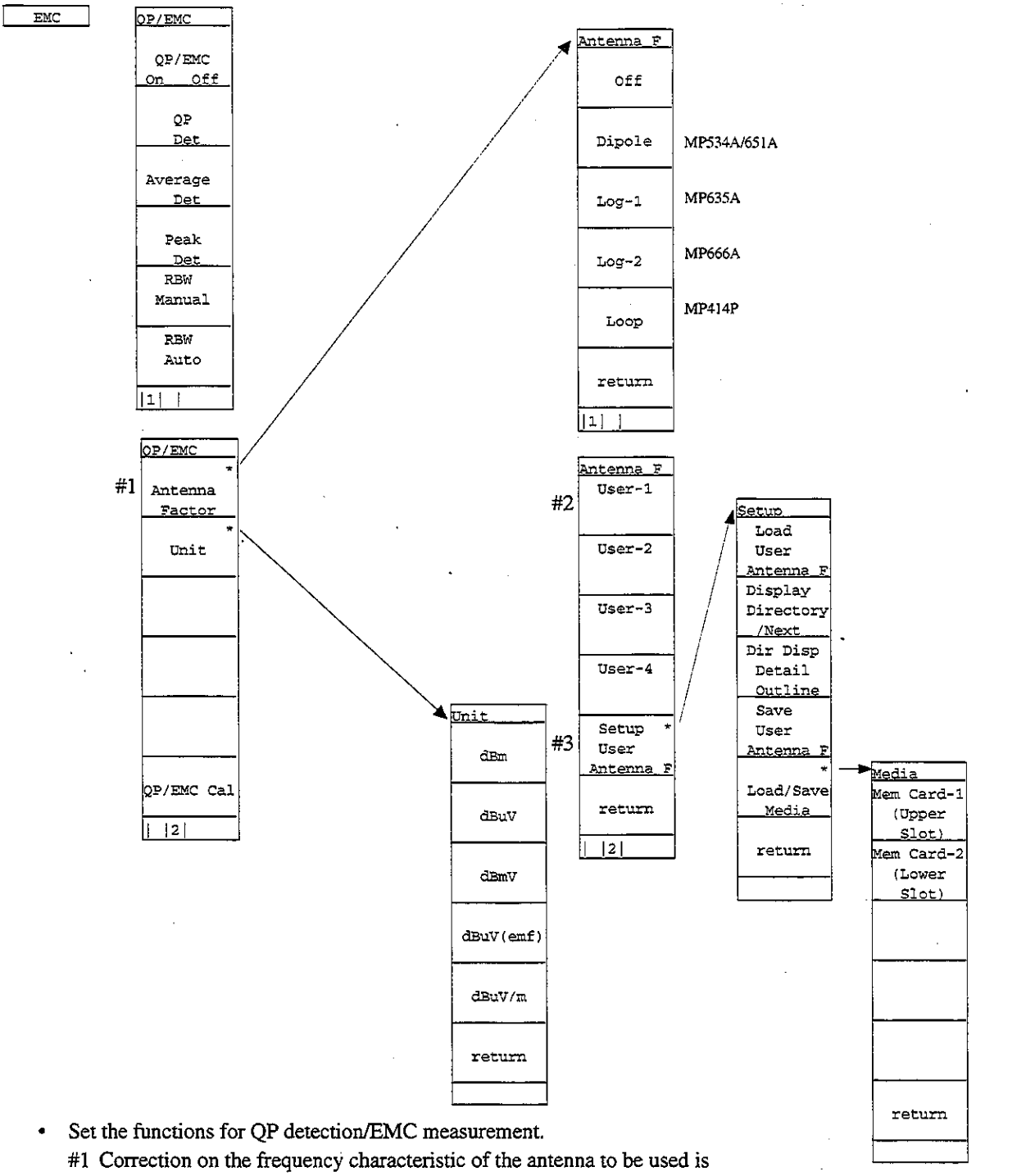
- Set interfaces for external devices to connect. Select RS232C, Centronics or GPIB, and set the RS232C interface, GPIB address, etc.



- Input a title to display on the screen.

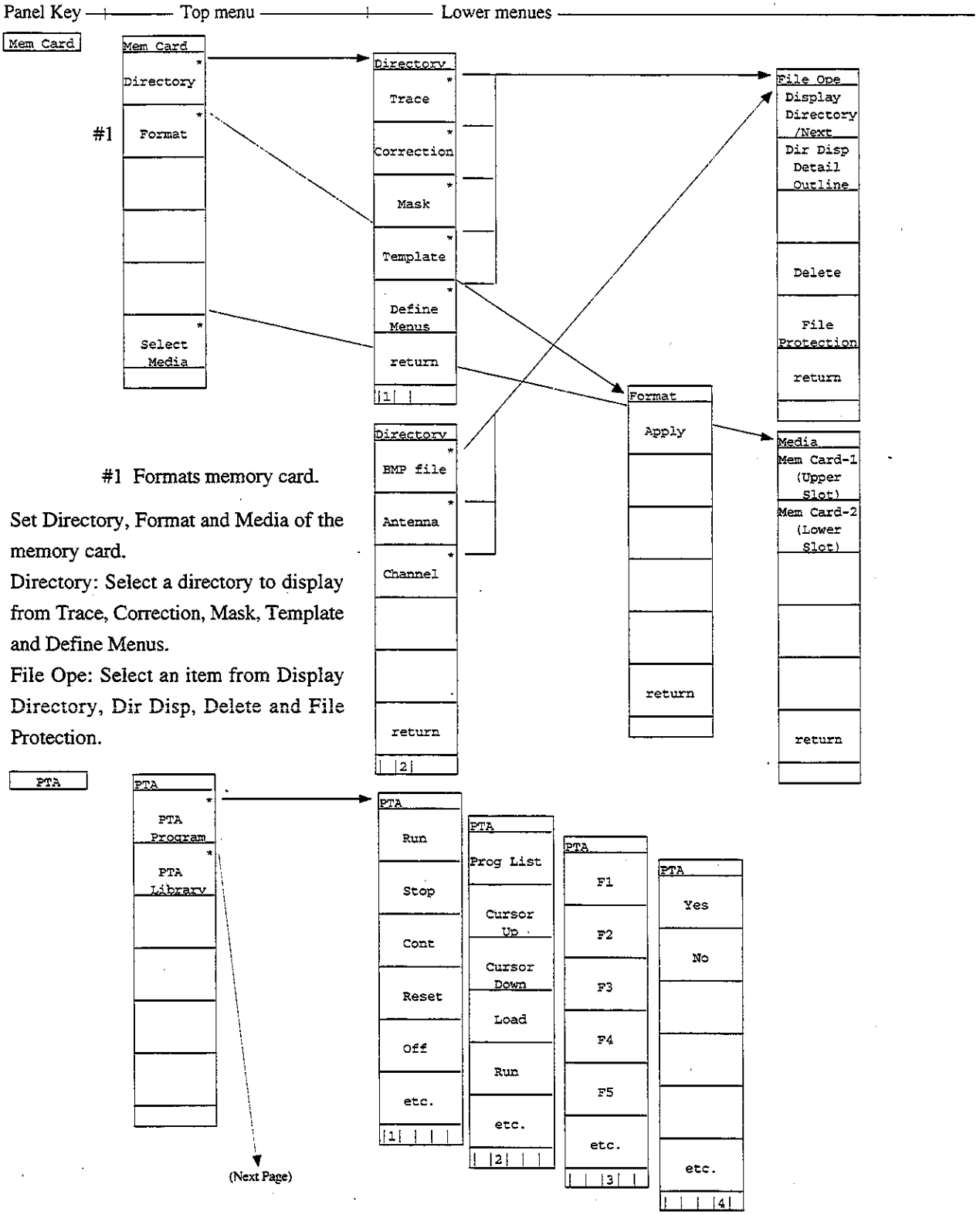


Menu Tree (24/28)



- Set the functions for QP detection/EMC measurement.
  - #1 Correction on the frequency characteristic of the antenna to be used is performed prior to measurements.
  - #2 When an user intends to use an own antenna, measurement is performed using its frequency characteristic correction data.
  - #3 Load/Save a user's antenna correction factor from/to memory card.

Menu Tree (25/28)

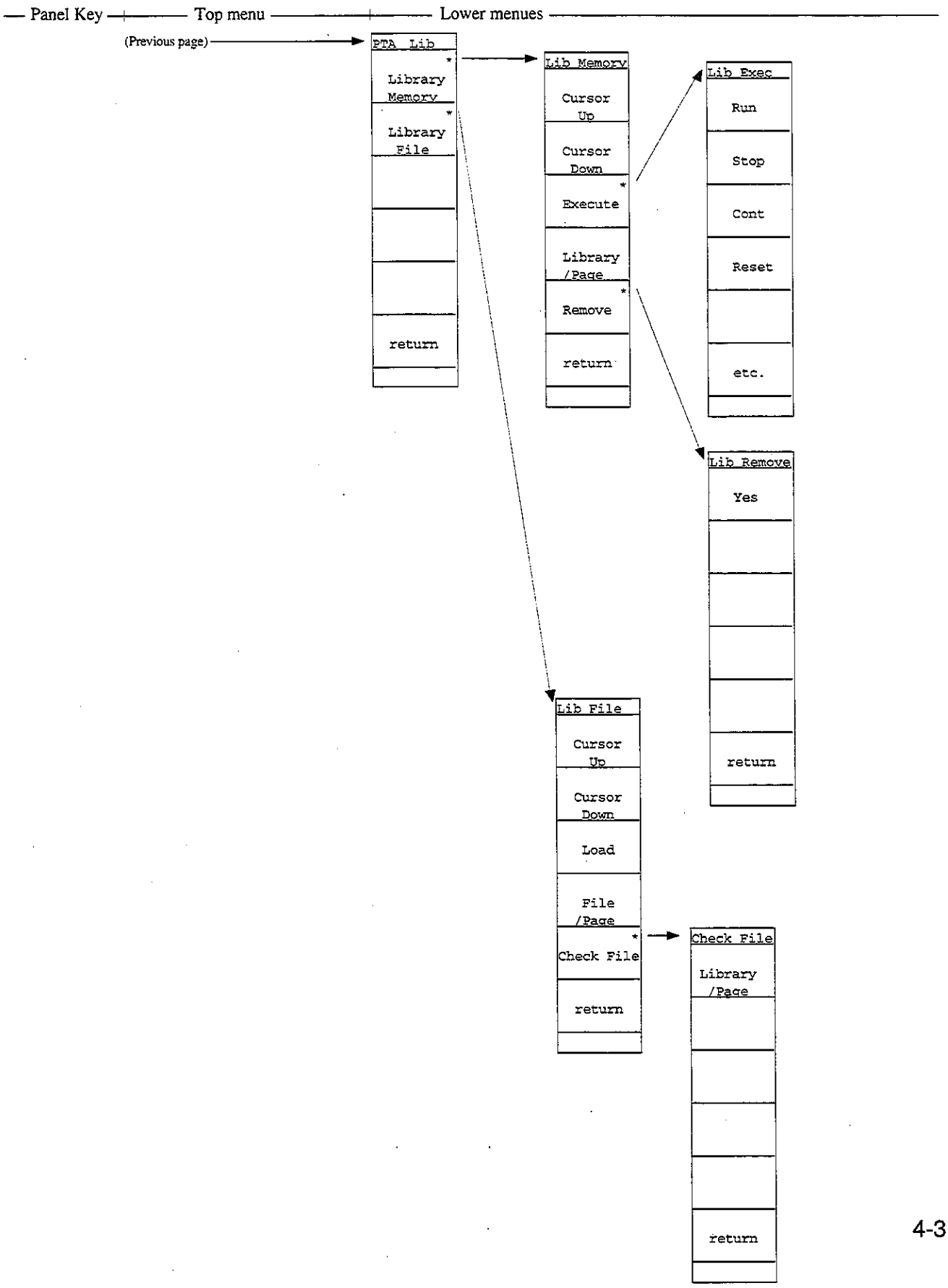


#1 Formats memory card.

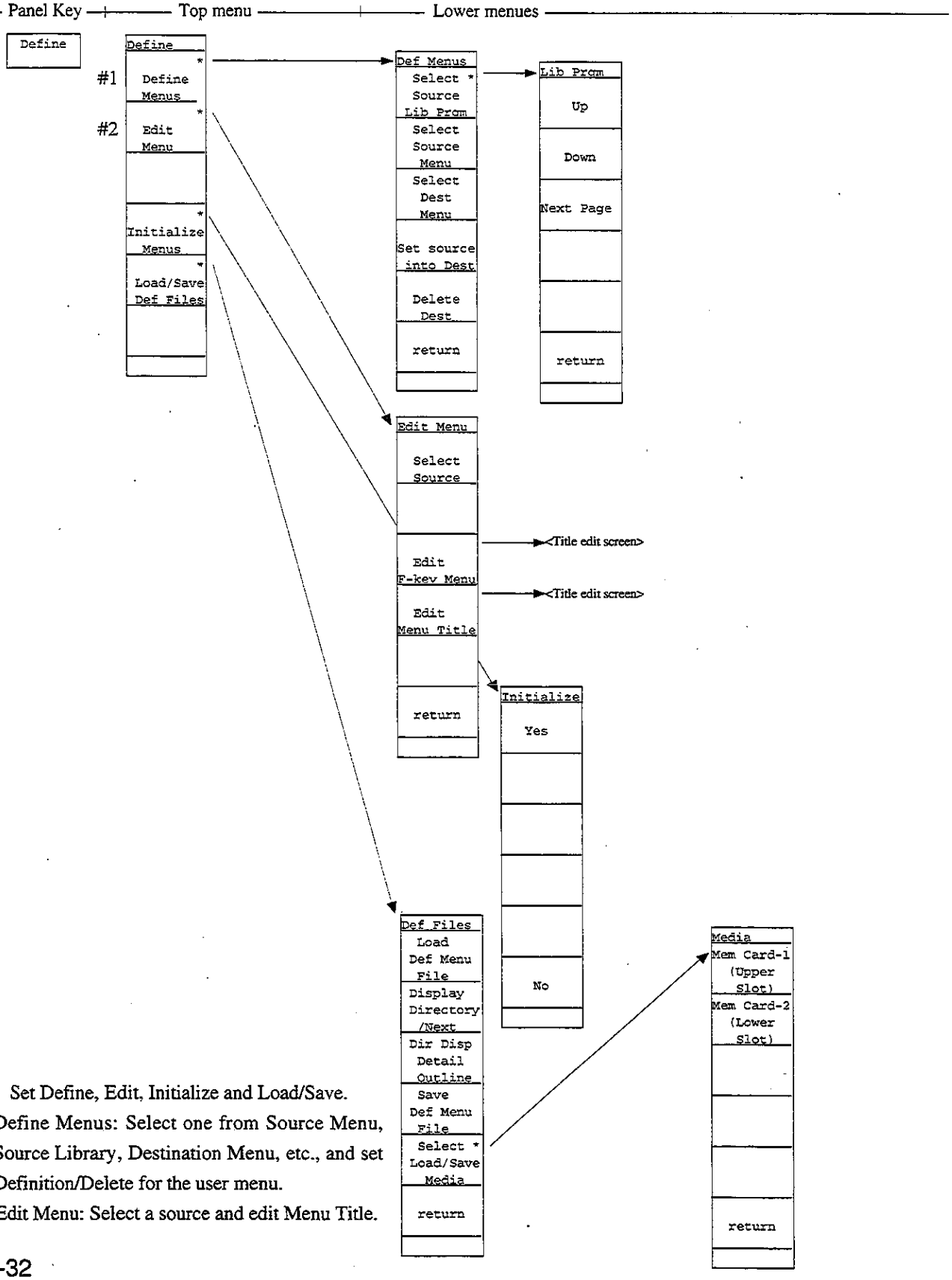
- Set Directory, Format and Media of the memory card.
  Directory: Select a directory to display from Trace, Correction, Mask, Template and Define Menus.
  File Ope: Select an item from Display Directory, Dir Disp, Delete and File Protection.

- Set PTA (personal test automation) that can build an auto measurement system without requiring external controllers.
  PTA Program: Select one from Run, Stop, Cont Reset, Prog List, Load, etc.
  PTA Library: Select one from Display/Run for the library program and Load/Check for the library file.

Menu Tree (26/28)



Menu Tree (27/28)



- Set Define, Edit, Initialize and Load/Save.

#1 Define Menus: Select one from Source Menu, Source Library, Destination Menu, etc., and set Definition/Delete for the user menu.

#2 Edit Menu: Select a source and edit Menu Title.

Menu Tree (28/28)

Panel Key	Top menu	Lower menues
Preset	Preset	• Initialize measurement parameters. Select one from All, Sweep, Trace, Level and Frequ/Time.
	Preset All	
	Preset Sweep controll	
	Preset Trace Parameters	
	Preset Level Parameters	
	Preset Freq/Time Parameters	
Hold		
Local		

SECTION 5

BASIC OPERATION PROCEDURE

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Check of the zone marker function

The "marker → CF" function check

"Measure" Function Check 5-8

Screen Hard Copy 5-9

SECTION 5
BASIC OPERATION PROCEDURE

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

([ ] : Panel key, ___ : Soft key)

<Actual operations>

(I) Signal display
  1) Turn the power on,
  2) execute automatic calibration,
  3) set the signal to the center of the screen, and
  4) enlarge and display the signal.

(II) Marker operation
  Check of the zone marker function.
  The "marker → CF" function check.

(III) "Measure" function check

(IV) Screen hard copy

Signal Display

Turn the power on

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

Press [Preset] key.

Press Preset All key in the menu.

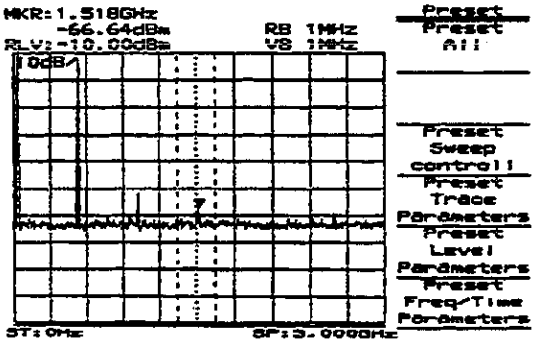

Fig. 5-1

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

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

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

Execute automatic calibration

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

After warm up, execute automatic calibration.

Press [Shift] key then [0 (CAL)] key.

Select All Cal from the menu displayed on the display.

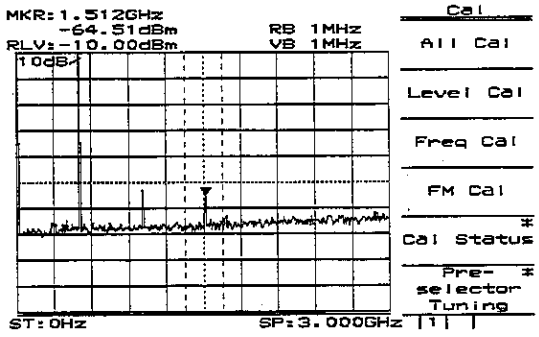

Fig. 5-2

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

Set the signal to the center of the screen

Press [Frequency] key.

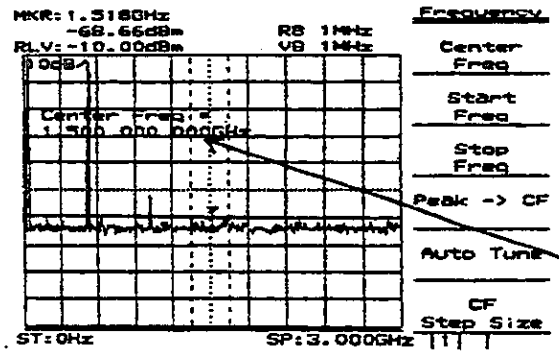

Fig. 5-3

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

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

Press [Menu On/Off] key

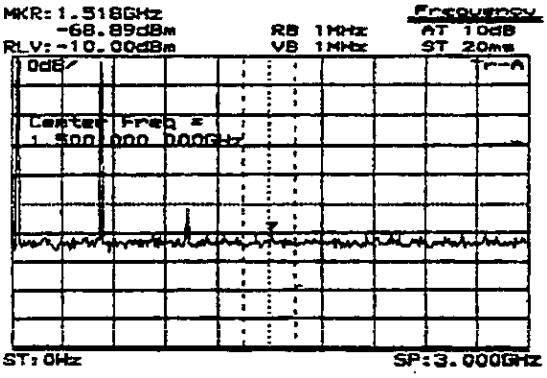

Fig. 5-4

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

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

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

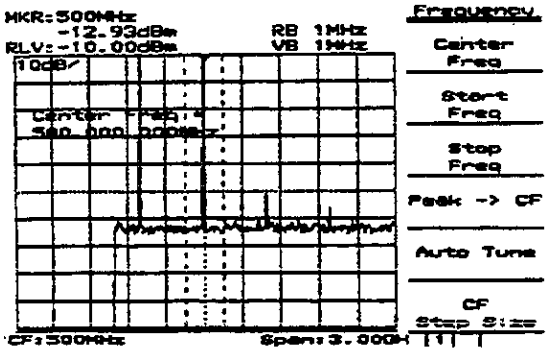

Fig. 5-5

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

Enlarge and display the signal

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

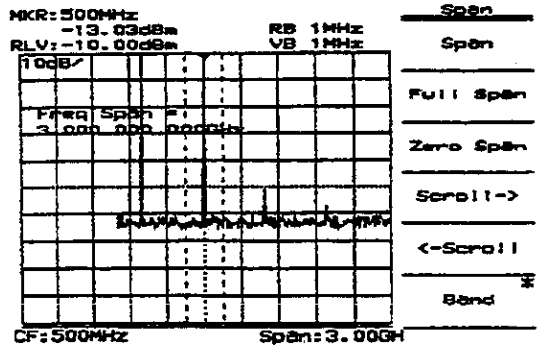

Fig. 5-6

Marker Operation

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

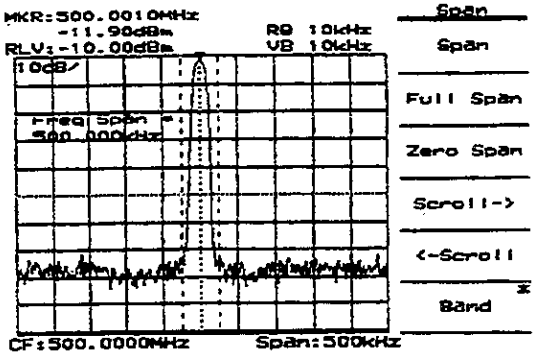

Fig. 5-7

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

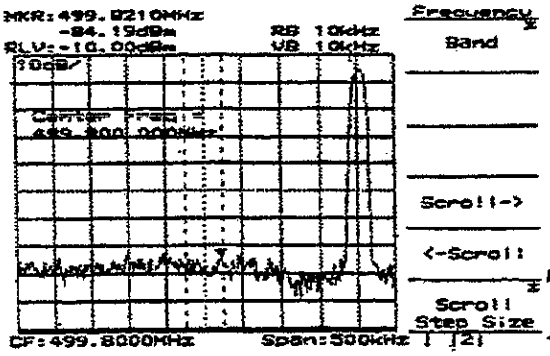

Fig. 5-8

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

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

To turn over the page, press [More] key.

Press [Marker] key.

Press Peak Search key.

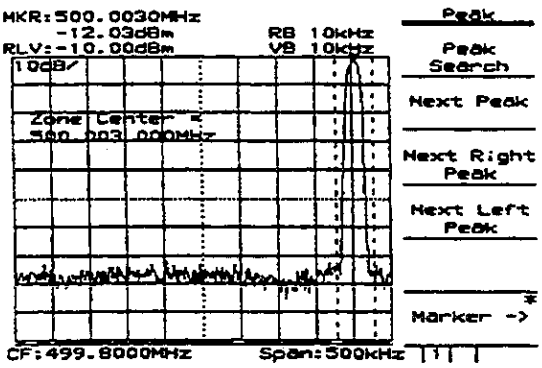

Fig. 5-9

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

The marker fetches the signal.

Press Marker → key.

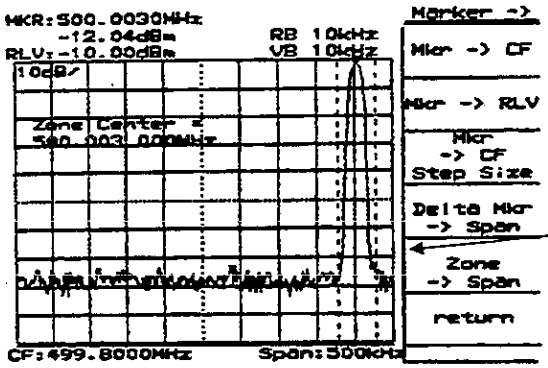

Fig. 5-10

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

Press marker → CF key.

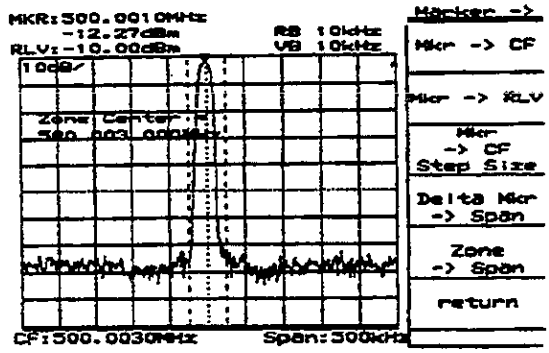

Fig. 5-11

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

Here, return to the screen of Fig. 5-8 and ensure that the screen changes to that of Fig. 5-11 only by pressing the [→ CF] key.

"Measure" Function Check

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

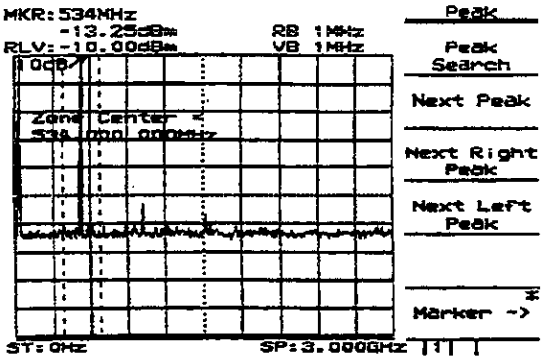

Fig. 5-12

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

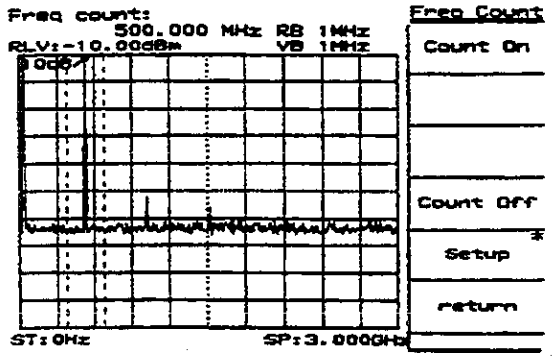

Fig. 5-13

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

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

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

Screen Hard Copy

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

1) As illustrated below, connect the RS-232C connector and printer with an attached RS-232C cable.

2) Press the [Copy] key, and the currently displayed screen is hard-copied.
If the printed copy is improper, check if the RS-232C interface is correctly set in the following sequence.

3) Press the [Shift] key and then the [Interface] key.

4) Press the Connect to Controller key several times to get None on the display, and press the Connect to Prt/Plt key several times and get RS-232C on the display.
Now the printer can be operated with RS-232C.

5) Press the RS232C Setup key and set so that (or check if) the setting of RS-232C interface is the same between the main body and printer.
(For the setting/checking of the RS-232C interface on the printer side, refer to the instruction manual of the printer.)

6) Press the [Shift] key and then the [Copy Cont] key.

7) Press the Printer/Plotter key and select Printer.

8) Press the Printer Setup key, and then press the VP-600 key.

9) Press the Magnify key several times and make the display 1 × 1.

10) Press the [Copy] key, and the currently displayed screen is hard-copied.

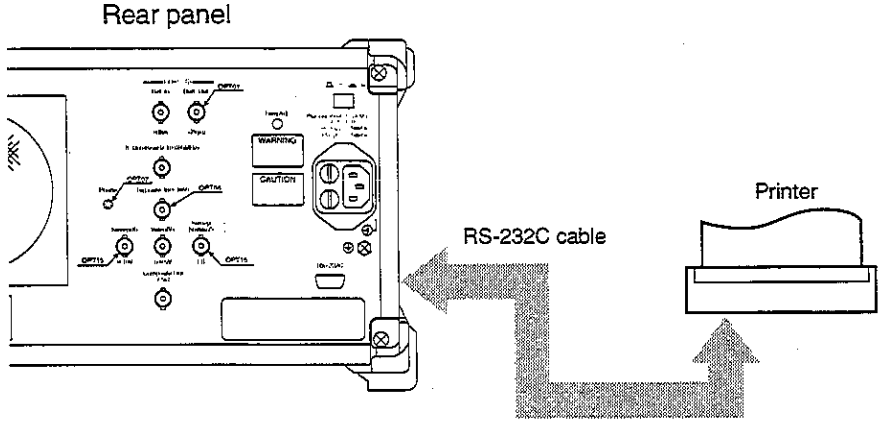

Fig. 5-14

SECTION 6
PERFORMANCE TESTS

In this chapter, measuring instruments, setup and operations necessary for conducting performance tests of MS2650/2660 series equipped with a reference oscillator (Option 01) are described. Note that with regard to performance tests of sideband noise level, mean noise level and second harmonic distortion, the standard of measured objects differ between MS2651A/ MS2653A and MS2661A/2663A.

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SECTION 6 PERFORMANCE TESTS

Requirement for Performance Tests

Performance tests are used as preventive maintenance to prevent degradation of the MS2650/MS2660 series performance before it occurs.
Use the performance tests whenever necessary such as at acceptance and periodic inspection of the MS2650/MS2660 series and to verify performance after repair. Execute the performance tests listed below to verify the MS2650/MS2660 series performance at acceptance inspection, periodic inspection and after repair.

- Reference oscillator frequency stability
- Center frequency display accuracy
- Frequency span display accuracy
- Resolution bandwidth and selectivity
- Sideband noise level
- Frequency measurement accuracy
- Amplitude display linearity
- Frequency response
- Reference level accuracy
- Average noise level
- Second harmonic distortion
- Resolution bandwidth (RBW) switching error
- Input attenuator switching error
- Sweep time and time span accuracy
- TG output level

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 tests, please contact Anritsu Corporation.

Instruments Required for Performance Test

A list of instruments required for performance test is shown below.

Instruments Required for Performance Test (1/2)

Recommended instrument name (Model name)	Required Performance †	Test item
Synthesized signal generator (MG3633A)	• Frequency range 100 MHz to 1 GHz Resolution of 1 Hz possible • Output level range − 20 to 0 dBm Resolution of 0.1 dB possible • SSB phase noise ≦ 130 dBc / Hz (at 10 kHz offset) • Second harmonic ≦ 30 dBc • Amplitude modulation (0% to 100%, 0.1 to 400 Hz) possible • External reference input (10 MHz) possible	Frequency-span display accuracy Resolution bandwidth, selectivity Sideband noise Amplitude display linearity Reference-level accuracy Second-harmonic distortion Resolution-bandwidth switching error Input-attenuator switching error Sweep-time and time-span accuracy
Swept Frequency Synthesizer (WILTRON 6769B with Option 2C)	• Frequency range 10 MHz to 8.1 GHz Resolution of 2 kHz possible • Output level range − 20 to 0 dBm Resolution of 0.1 dB possible • Pulse modulation possible Pulse width: 0.5 to 10 μ sec Repetitive cycle: 5 μ sec to 5 msec • External reference input (10 MHz) possible	Center-frequency display accuracy Frequency-span display accuracy Frequency measurement accuracy Frequency response Time-span accuracy
Attenuator (MN510C)	• Frequency 100 MHz • Maximum attenuation 70 dB (resolution 0.1 dB) possible with calibrated data	Amplitude display linearity Input-attenuator switching error

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

Instruments Required for Performance Test (2/2)

Recommended instrument name (Model name)	Required Performance †	Test item
Power meter (ML4803A)	• Main instrument accuracy ± 0.02 dB • Frequency range 100 kHz to 3 GHz (depending on the power sensor type)	Frequency response Reference-level accuracy Input-attenuator switching error TG output level
Power sensor (MA4601A)	• Frequency range 100 kHz to 2 GHz • Measurement power range − 30 to +10 dBm • Input connector N type	Frequency response Reference-level accuracy Input-attenuator switching error TG output level
Power sensor (MA4701A)	• Frequency range 10 MHz to 8.1 GHz • Measurement power range − 30 to +10 dBm • Input connector N type	TG output level
Power Sensor (MA4602A)	• Frequency range 100 kHz to 3 GHz • Measurement power range − 60 to − 30 dBm • Input connector N type	
50 Ω terminator (MP752A)	• Frequency range DC to 8.5 GHz • VSWR ≦ 1.2	Average noise level
50 Ω terminator WILTRON (28KF50)	• Frequency range DC to 8.1 GHz • VSWR ≦ 1.15	
Low-pass filter (M-238C) (SAGE L20CA072)	• Attenuation ≧ 70 dB (at frequency: 2 × (10 MHz and 1 GHz))	Second-harmonic distortion
Frequency counter (MF1601A)	10 MHz measurement possible Number of display digits: 10 • External reference input (10 MHz) possible	Reference-oscillator frequency stability
Frequency standard	• Frequency 10 MHz • Stability ≦ 1×10^{-9}/day	Reference-oscillator frequency stability

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

Performance Test

The warm-up time depends on the test item. For test item other than oscillator frequency, warm-up the equipment for at least for thirty minutes and test the performance after the MS2650/MS2660 series stabilizes completely. Also, begin measurement after taking the warm-up time of the calibration instrument into full consideration. In addition, the test must be conducted at room temperature; there must be little AC power supply voltage fluctuation, and no noise, vibration, dust, humidity, etc.

Reference oscillator frequency stability

The optional 10 MHz reference oscillator (Option 01) is tested for frequency stability.
Stability is determined by measuring frequency variation after 24 hours and after 48 hours of power on at ambient temperatures of 0°C and 50°C.
If a device is not to mount Option 01, this test is not available since there is no 10 MHz reference buffer output.

(1) Specifications (Option 01)

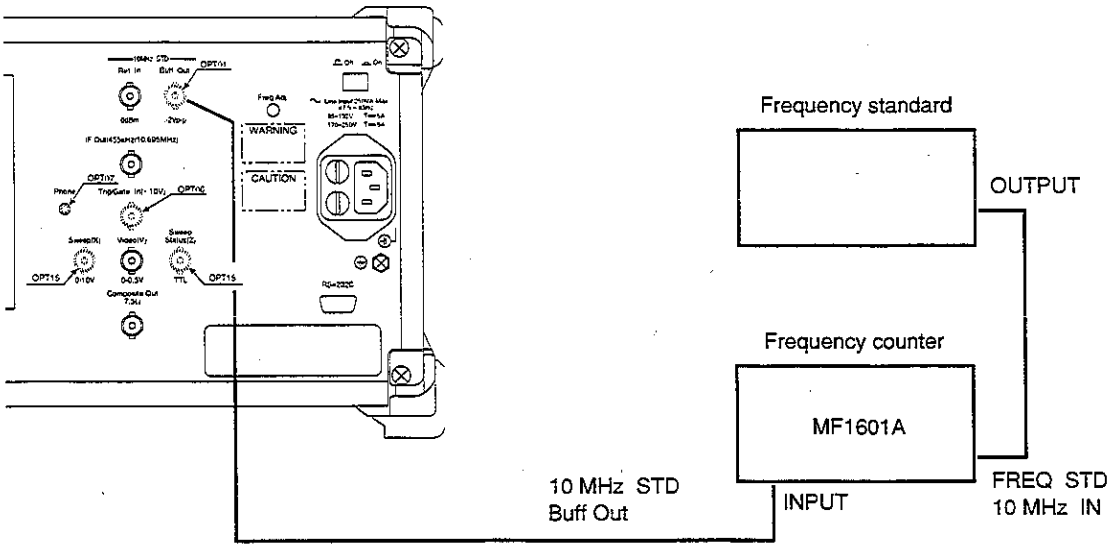
■ Reference oscillator

- Frequency: 10 MHz
- Aging rate: $\leqq \pm 2 \times 10^{-8}$/ day
  After 24 hour warm-up at 25°C ± 5°C
- Temperature stability: $\leqq \pm 5 \times 10^{-8}$ at 0 and 50°C referred to frequency at 25°C

(2) Test instruments

- Frequency counter: MF1601A
- Frequency standard: with stability of $\leqq \pm 1 \times 10^{-9}$/ day

(3) Setup



Reference Oscillator Frequency Stability Test

(4) Procedure

Aging rate / day: Test this at the ambient temperature ± 2℃ in a vibration-free place.

Step	Procedure
1	Set the change over switch (FREQ STD: INT / EXT) on the MF1601A counter rear panel to EXT.
2	Set the power supply switch on the spectrum analyzer rear panel to On and then the Power switch on the spectrum analyzer front panel to On.
3	Measure the frequency using the counter with 0.1 Hz resolution after 24 hours have passed after turning the power ON.
4	Measure the frequency using the counter after 24 more hours have passed from the step 3 measurement.
5	Calculate the stability by using the following equation.

$$\text{Frequency stability} = \frac{\text{(2nd reading of the counter)} - \text{(1st reading of the counter)}}{\text{(1st reading of the counter)}}$$

Temperature stability: Test this performance in a vibration-free constant-temperature chamber.

Step	Procedure
1	Set up the spectrum analyzer in a constant-temperature chamber at 25°C in the same setup.
2	Set the LINE and Power switches on the spectrum analyzer to On and wait until the spectrum analyzer 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 Hz resolution.
4	Change the chamber temperature to 50°C.
5	When the chamber temperature and the spectrum analyzer internal temperature re-stabilize, measure the frequency by using the counter.
6	Calculate the stability by using the following equation. $\text{Frequency stability} = \frac{(\text{counter reading at } 50℃) - (\text{counter reading at } 25℃)}{(\text{counter reading at } 25℃)}$
7	Change the chamber temperature to 0°C and repeat steps 5 and 6.

Center frequency readout accuracy

Add the known frequency which serves as the center frequency reference to the spectrum analyzer as shown in the figure below and set CF (same value as the known reference frequency) and SPAN. At this time, check that the difference between the reading of the marker readout frequency (thick arrow in the figure) of the center frequency peak point, and the CF set value is ≦ ± (span × span accuracy +100 Hz).

As shown in the figure, the Synthesized Signal Generator uses the signal source phase-locked with the same accuracy as the 10 MHz reference oscillator of the spectrum analyzer.

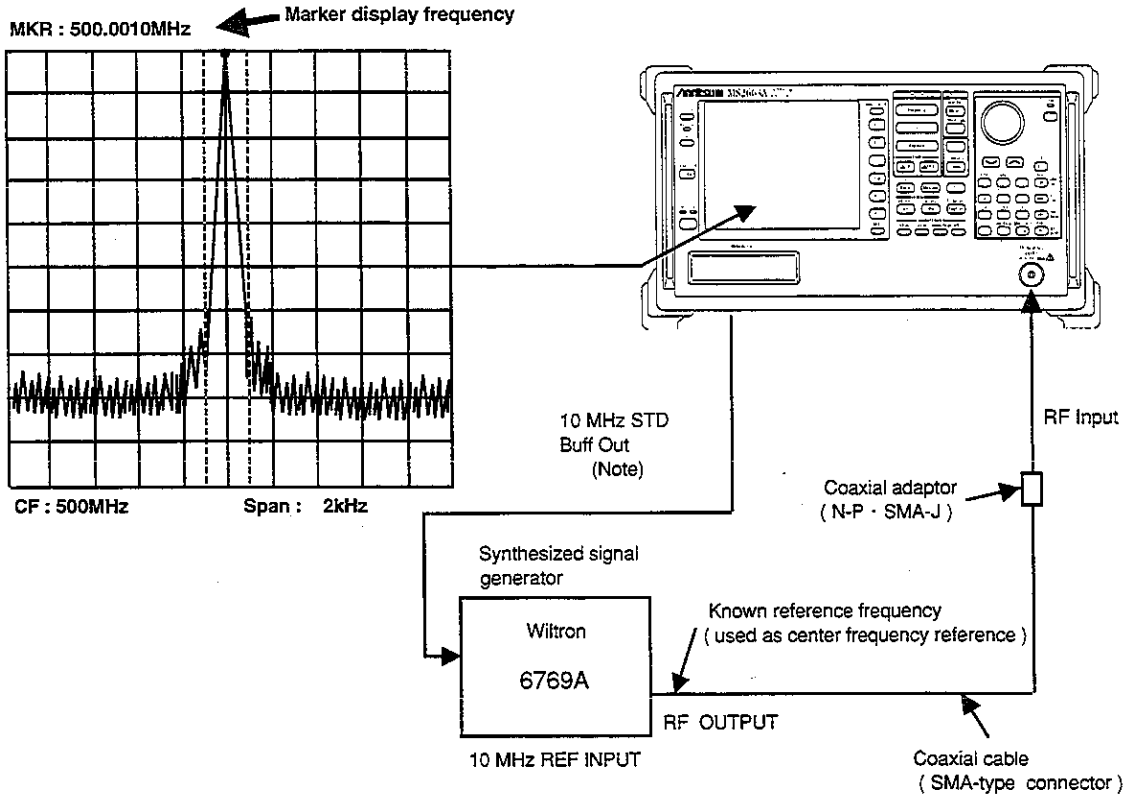
(1) Specifications

- Center frequency accuracy: ± (Indicated frequency × reference frequency accuracy + span × span accuracy + 100 Hz) ; * Span ≧ 10 kHz (after calibration)

(2) Test instruments

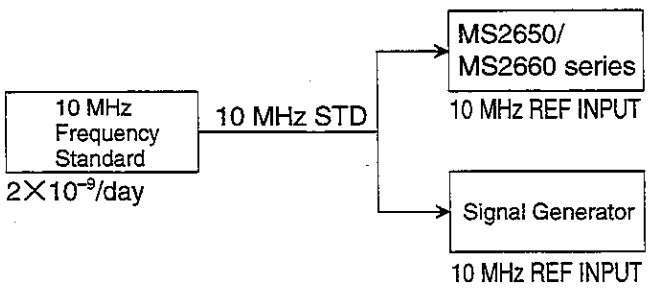
- Synthesized signal generator: Wiltron 6769A

(3) Setup



Center-Frequency Readout-Accuracy Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator, as shown below.



(4) Precautions

Set the signal generator output level to approx − 10 to − 20 dBm.

(5) Procedure

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate Freq Cal.
3	Set the signal generator output frequency equal to the center frequency (500 MHz) in the following table.
4	Set the spectrum analyzer to the center frequency in the following table.
5	Set the span (10 kHz) that corresponds to the center frequency (500 MHz) in the table by using the numeric/unit keys.
6	Read the marker frequency (indicated by thick arrow in the figure on the previous page) and check that the value is within the range between the maximum and minimum values shown in the following table.
7	Repeat steps 3 to 6 for other combination of the center frequency and span according to the combinations shown in the following table.

Center frequency display accuracy test

• MS2651A/2661A

Signal generator	Center frequency	Span frequency	Center frequency		
			Minimum value	Maker value	Maximam value
500 MHz	500 MHz	10 kHz	499.999 65		500.000 35
		200 kHz	499.994 90		500.005 10
		100 MHz	497.499 90		502.500 10

• MS2653A/2663A

Signal generator	Center frequency	Span frequency	Band	Center frequency		
				Minimum value	Maker value	Maximam value
500 MHz	500 MHz	10 kHz	0 (1)	499.999 65 MHz		500.000 35 MHz
		200 kHz		499.994 90 MHz		500.005 10 MHz
		100 MHz		497.499 90 MHz		502.500 10 MHz
5 GHz	5 GHz	10 kHz	1^{-} (1)	4.999 999 65 GHz		5.000 000 35 GHz
		200 kHz		4.999 994 90 GHz		5.000 005 10 GHz
		100 MHz		4.997 499 90 GHz		5.002 500 10 GHz
500MHz	500MHz	10 kHz	1^{+} (1)	7.499 999 65 GHz		7.500 000 35 GHz
		200 kHz		7.499 994 90 GHz		7.500005 10 GHz
		100 MHz		7.497 499 90 GHz		7.502 500 10 GHz

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 SG. The frequency difference between the peak levels at the 1st and 9th divisions is equal to the frequency span × 0.8.

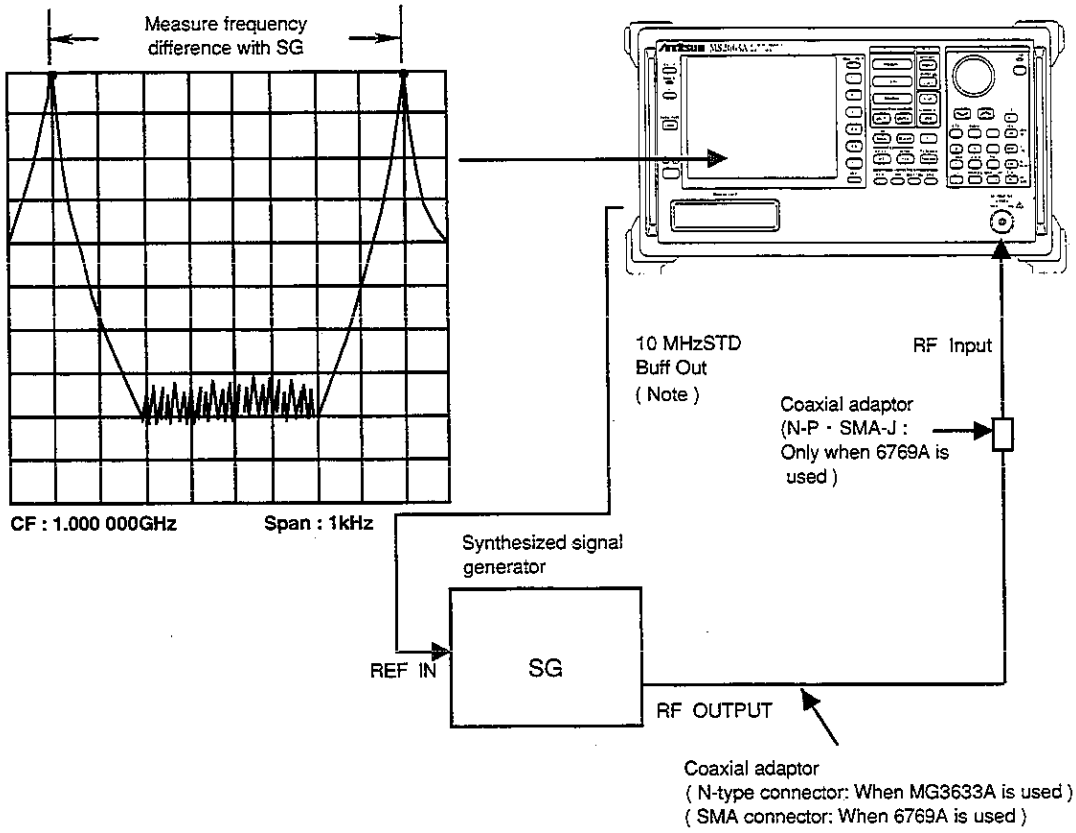
(1) Specifications

- Frequency span accuracy: ± 2.5% (span ≧ 10 kHz)

(2) Test instrument

- Synthesized signal generator: MG3633A
  Wiltron 6769A

(3) Setup



Frequency Readout Accuracy Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

(4) Precautions

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

(5) Procedure

Step	Procedure
1	Press the [Preset] key.
2	Operate Freq Cal.
3	Connect the MG3633A output to the spectrum analyzer RF Input.
4	Set the spectrum analyzer as shown below: Span ..... 20 kHz Center Freq ..... 1000 MHz
5	Set the MG3633A output frequency to the f_1 frequency (999.992 MHz) shown in the table on the next page.
6	Adjust the MG3633A output frequency to set the spectrum peak at the 1st division from the left end of the screen scale. Remember the frequency as f_1' .
7	After setting the MG3633A output frequency to the f_2 frequency (1000.008 MHz), adjust it to set the spectrum peak at the 9th division. Remember the frequency as f_2'.
8	Calculate ($f_2' - f_1'$) / 0.8 and check that the value is within the specified range (minimum to maximum values) shown in the table on the next page.
9	Repeat steps 4 through 8 for each frequency span with 1 GHz center frequency shown in the table on the next page.

Frequency-Span Readout-Accuracy Test

MS2651A/MS2661A		Signal generator				
Center frequency	Span	f_1	f_2	Minimum value	$\frac{f_2' - f_1'}{0.8}$	Maximum value
1 GHz	20 kHz	0.999 99 2 GHz	1.000 008 GHz	19.5 kHz		20.5 kHz
	200 kHz	0.999 92 GHz	1.000 08 GHz	195 kHz		205 kHz
	2 MHz	0.999 2 GHz	1.000 8 GHz	1.95 MHz		2.05 MHz
	10 MHz	0.996 GHz	1.004 GHz	9.75 MHz		10.25 MHz
	100 MHz	0.96 GHz	1.04 GHz	97.5 MHz		102.5 MHz
	2 GHz	0.2 GHz	1.8 GHz	1.95 GHz		2.05 GHz

MS2653A/MS2663A		Signal generator				
Center frequency	Span	f_1	f_2	Minimum value	$\frac{f_2' - f_1'}{0.8}$	Maximum value
1 GHz	20 kHz	0.999 99 2 GHz	1.000 008 GHz	19.5 kHz		20.5 kHz
	200 kHz	0.999 92 GHz	1.000 08 GHz	195 kHz		205 kHz
	2 MHz	0.999 2 GHz	1.000 8 GHz	1.95 MHz		2.05 MHz
	10 MHz	0.996 GHz	1.004 GHz	9.75 MHz		10.25 MHz
	100 MHz	0.96 GHz	1.04 GHz	97.5 MHz		102.5 MHz
	2 GHz	0.2 GHz	1.8 GHz	1.95 GHz		2.05 GHz
4.25 GHz	100 kHz	4.21 GHz	4.29 GHz	97.5 MHz		102.5 MHz
	1 MHz	3.85 GHz	4.65 GHz	0.975 GHz		1.025 GHz
	8.5 MHz	0.85 GHz	7.65 GHz	8.2875 GHz		8.7125 GHz

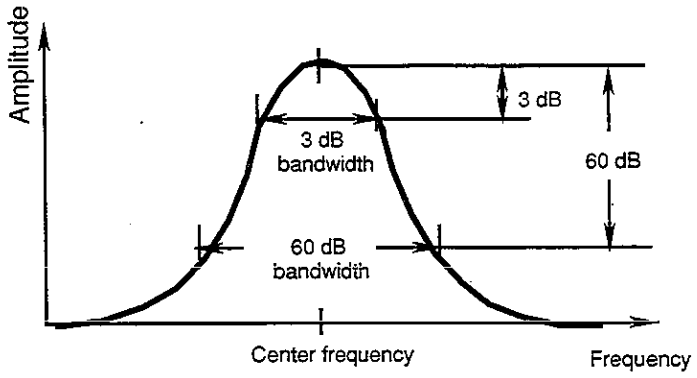
Resolution bandwidth (RBW) and selectivity

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

This is called the resolution bandwidth.

Selectivity can be improved by narrowing the 60 dB bandwidth. The selectivity is defined by the ratio of the filter width, in Hz, at the -60 dB point, to the filter width, in Hz, at the -3 dB point, as shown in the formula below.

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



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

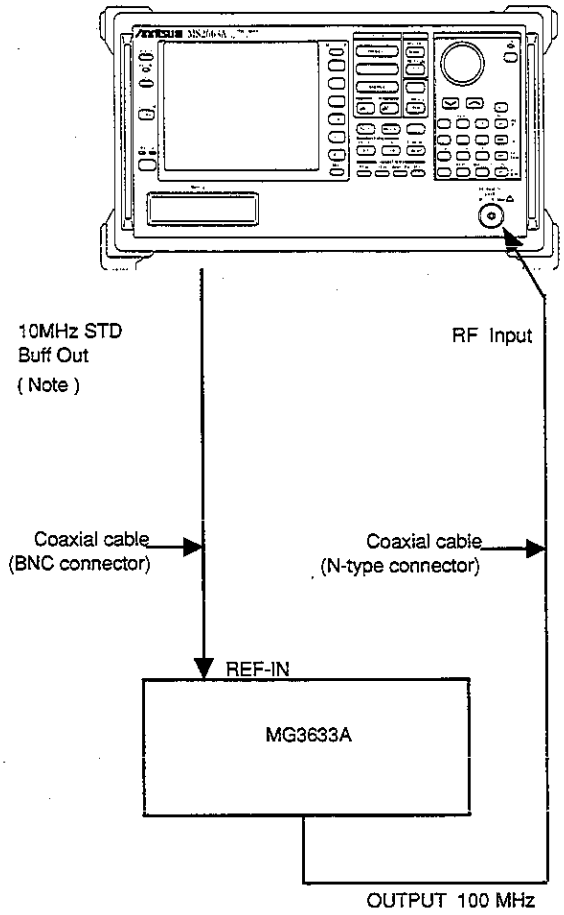
(1) Specifications

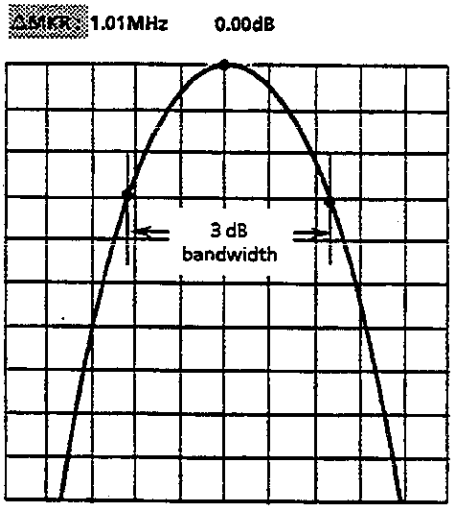
- Selectivity (60 dB / 3 dB bandwidth): ≦ 15:1 (1 MHz, 5 MHz)
  ≦ 10:1 (1, 3, 10, 30, 100, 300 kHz)

(2) Test instrument

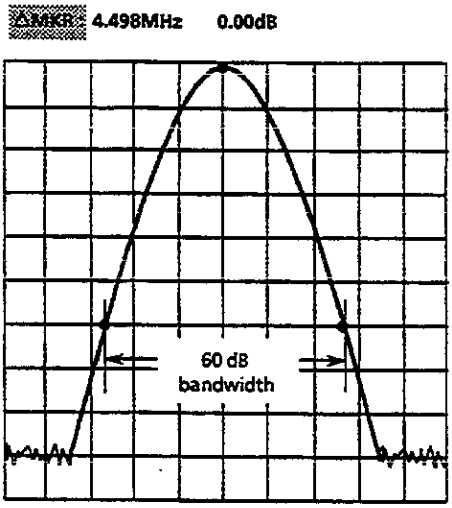
- Synthesized signal generator: MG3633A

(3) Setup





(a) Resolution bandwidth



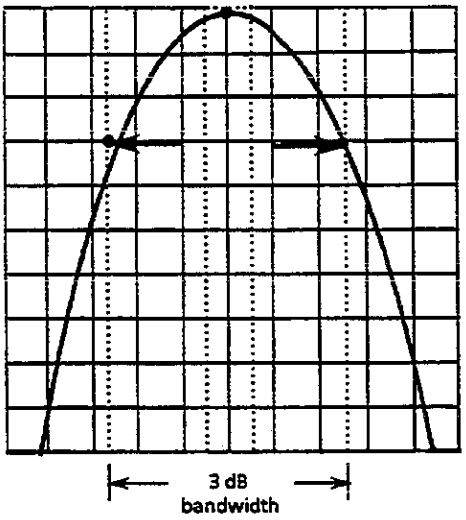
(b) 60 dB dropped bandwidth

Resolution Bandwidth / Selectivity Test

(4) Procedure

(a) Resolution bandwidth accuracy

Step	Procedure
1	Press the [Preset] key.
2	Perform all calibration.
3	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 10 MHz RBW (MANUAL) ..... 5 MHz Scale ..... LOG 1 dB / div
4	Press the [→ RLV] key and match the peak of the signal trace to the top line (REF LEVEL) on the screen.
5	Press the [Signal] key to execute a single sweep, then check that the single sweep has been completed.
6	After pressing the Measure key, operate Occ BW Measure and Setup and display the setup menu of occupied frequency bandwidth measurement.
7	Select XdB Down and set it to 3 dB.
8	Press Return to return to the Occ BW Measure menu, and then press Execute.
9	The 3 dB resolution bandwidth value is displayed in the upper left-hand corner of the screen. Fill in this value in the table on the next page.
10	Repeat steps 3 to 9 for the frequencies other than the resolution bandwidth 5 MHz and the frequency span 10 MHz according to the combinations of resolution bandwidth and frequency span shown in the table on the next page.



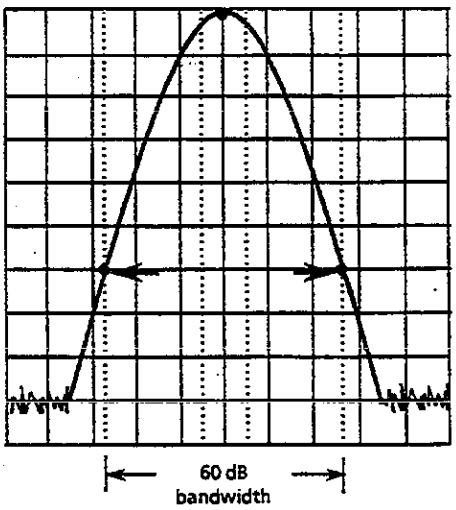
Bandwidth Measurement

Resolution Bandwidth (3 dB)

Resolution bandwidth	Frequency span	3 dB bandwidth
5 MHz	10 MHz	
1 MHz	5 MHz	
300 kHz	500 kHz	
100 kHz	200 kHz	
30 kHz	50 kHz	
10 kHz	20 kHz	
3 kHz	5 kHz	
1 kHz	2 kHz	

(b) Resolution bandwidth selectivity

Step	Procedure
1	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 200 MHz RBW (MANUAL) ..... 5 MHz Scale ..... LOG 10 dB / div VBW ..... 100 Hz Marker ..... NORMAL Zone Width ..... 10 MHz
2	Press the [→RLV] key to match the peak of the signal trace to the top line (REF LEVEL) on the screen.
3	Press the [Single] key to execute a single sweep, then check that the single sweep has been completed.
4	After pressing the Measure key, operate Occ BW Measure and Setup and display the setup menu of occupied frequency bandwidth measurement.
5	Select XdB Down and set it to 60 dB.
6	Press Return to return to the Occ BW Measure menu, and then press Execute.
7	The 60 dB resolution bandwidth value is displayed in the upper left-hand corner of the screen. Fill in this value in the table on the next page.
8	Repeat steps 1 to 7 for the frequencies other than the resolution bandwidth 5 MHz and the frequency span 100 MHz according to the combinations of resolution bandwidth and frequency span shown in the table on the next page.
9	For the 3 dB bandwidth, too, write the value of the Resolution Bandwidth (3 dB) table on the preceding page in the table on the next page.
10	For each resolution bandwidth in the table on the next page, confirm that the value calculated from (60 dB BW / 3 dB BW) is ≦ 15 or ≦ 12.



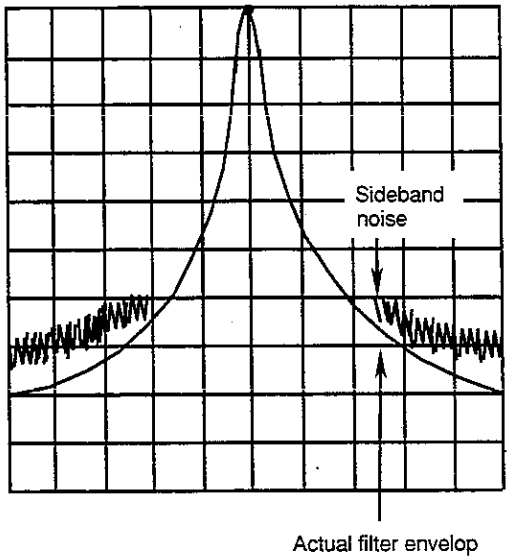
60 dB Bandwidth Measurement

Selectivity Test (60 dB / 3 dB Bandwidth Ratio)

Resolution bandwidth	Frequency span	Video span	Frequency span	Frequency span	Frequency span
5 MHz	200 MHz	100 Hz			
1 MHz	50 MHz	100 Hz			
300 kHz	20 MHz	100 Hz			
100 kHz	10 MHz	100 Hz			
30 kHz	200 kHz	100 Hz			
10 kHz	100 kHz	100 Hz			
3 kHz	20 kHz	100 Hz			
1 kHz	10 kHz	10 Hz			

Sideband noise

When the resolution bandwidth is set to a fixed value and a signal that has far less sideband-noise level than the equipment to be tested is input, check the level of the noise as compared to the peak signal (dBc) at the specified frequency away from the peak.



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

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

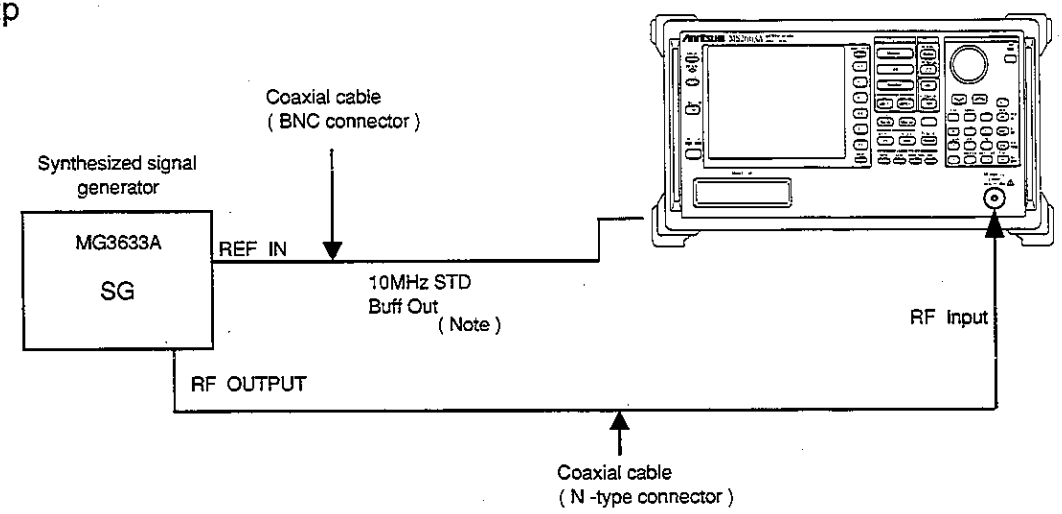
(1) Specifications

- Sideband noise: ≦ − 100 dBc / Hz (Frequency: 1 GHz, 10 kHz offset; MS2661A/2663A)
  ≦ − 90 dBc / Hz (Frequency: 1 GHz, 10 kHz offset; MS2651A/2653A)

(2) Test instruments

- Signal generator: MG3633A Synthesized Signal Generator

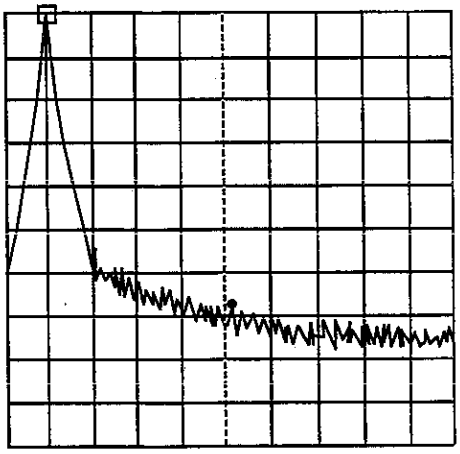
(3) Setup



Sideband Noise Test

(4) Procedure

Step	Procedure
1	Press the [Preset] key.
2	Operate All Cal.
3	Set the MG3633A output to 1000 MHz and 0 dBm.
4	Set the spectrum analyzer as shown below: Center Freq ..... 1.000 010 GHz Span ..... 25 kHz Reference Level ..... 0 dBm Attenuator ..... 10 dB RBW ..... 1 kHz VBW ..... 10 Hz DET MODE ..... SAMPLE
5	Press the [Peak Search] key to search for a peak point so that the peak point on the signal trace is included in the zone marker.
6	Press the [→ RLV] key to match the peak of the signal trace to the top line (REF LEVEL) on the screen.
7	After pressing the Measure key, select C/N Ratio Measure.
8	Press the Meas On key to start C/N measurement.
9	Set Zone Width of Marker to Spot.
10	Press the [Marker] key, then turn the rotary knob to move the zone marker to the right so that the zone center frequency is 10.0 kHz.
11	Make sure that the C/N value is −100 dBc/Hz or less (MS2661A/2663A) or −90 dBC/Hz or less (MS2651A/2653A).



Sideband Noise Measurement

Frequency measurement accuracy

Set the marker point to the position at least 20 dB higher than the noise (or adjacent interference signal) to operate the built-in counter (Option 03) with the higher-S/N signal, and test the frequency measurement accuracy using Count On mode. (This test cannot be performed without Option 03.)

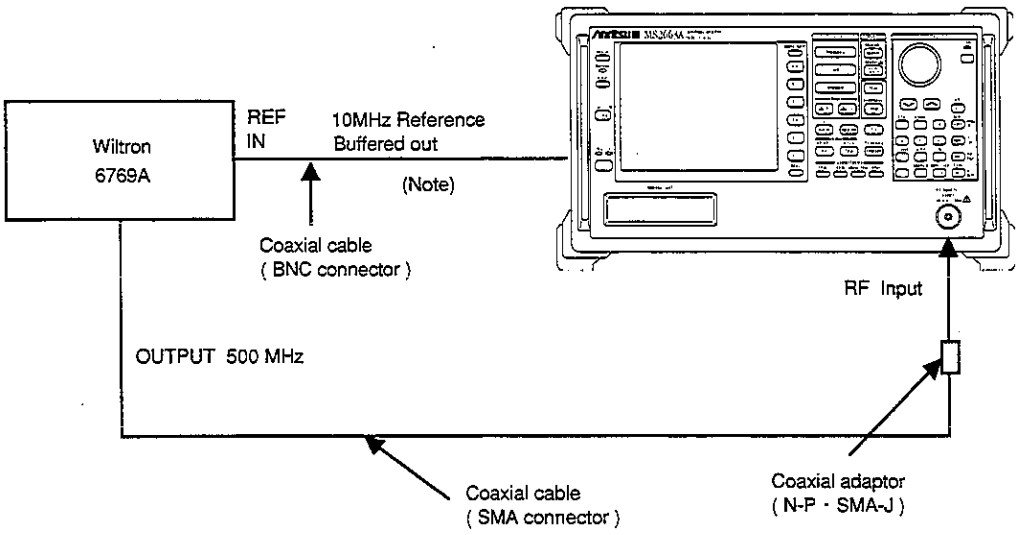
(1) Specifications

- Accuracy: ≦ (Readout frequency × reference oscillator accuracy ± (1 count))
- Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz

(2) Test instrument

- Signal generator: Wiltron 6769A

(3) Setup

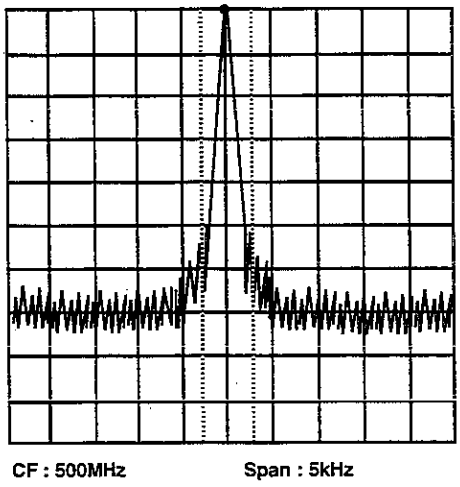


Frequency Measurement Accuracy Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

(4) Procedure

Step	Procedure
1	Press the [Preset] key.
2	Set the 6769A to 500 MHz and −10 dBm.
3	Set the spectrum analyzer as shown below: Center Freq ..... 500 MHz Span ..... 5 kHz
4	Press the [Measure] key and set to Frequency Count. Press Setup and set Resolution to 1 Hz. Then, press the Return key and set to Count On.
5	Confirm that the FREQ reading at the upper-left of the screen is the RF INPUT frequency 500 MHz ± 1 Hz or less.
6	Change the counter resolution to 10 Hz and confirm that the Freq reading is 500 MHz ± 10 Hz or less.
7	• Change the counter resolution to 100 Hz and confirm that the Freq reading is 500 MHz ± 100 Hz or less. • Change the counter resolution to 1 kHz and confirm that the Freq reading is 500 MHz ± 1 kHz or less.



Frequency Measurement

Amplitude display linearity

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

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

(1) Specifications

- Amplitude display linearity: After automatic calibration

• MS2651A/2661A

LOG: ± 2.5 dB for 0 to − 90 dB (RBW ≦ 10 kHz)
± 1.5 dB for 0 to − 85 dB (RBW ≦ 10 kHz)
± 1 dB for 0 to − 70 dB (RBW ≦ 100 kHz)
± 0.3 dB for 0 to − 20 (RBW ≦ 1 MHz)

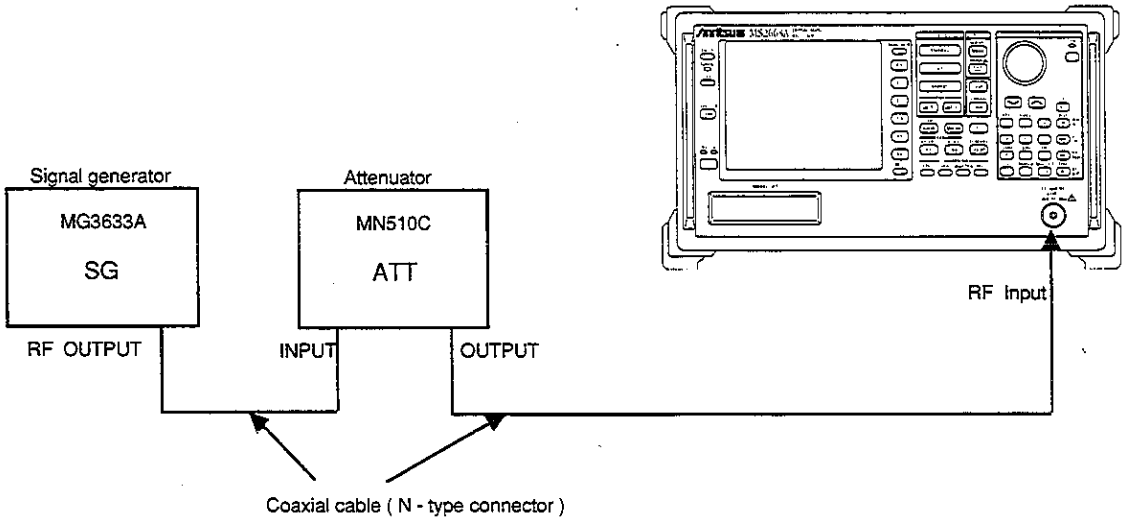
• MS2653A/2663A

LOG: ± 2.5 dB for 0 to − 90 dB (RBW ≦ 10 kHz)
± 1.5 dB for 0 to − 85 dB (RBW ≦ 10 kHz)
± 1 dB for 0 to − 70 dB (RBW ≦ 100 kHz)
± 0.4 dB for 0 to − 20 (RBW ≦ 1 MHz)

(2) Test instruments

- Signal generator: MG3633A
- Attenuator: MN510C

(3) Setup



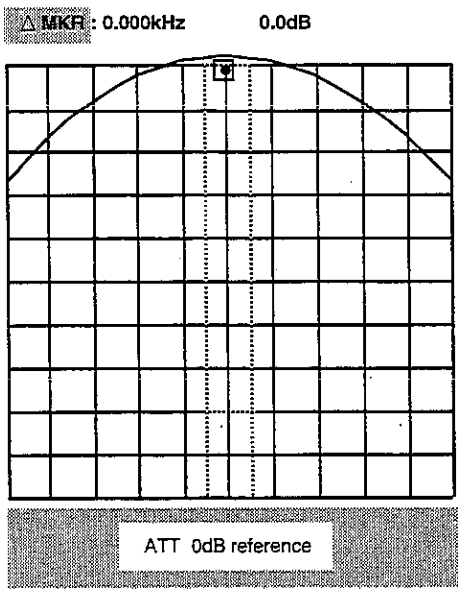
Amplitude Display Linearity Test

(4) Procedure

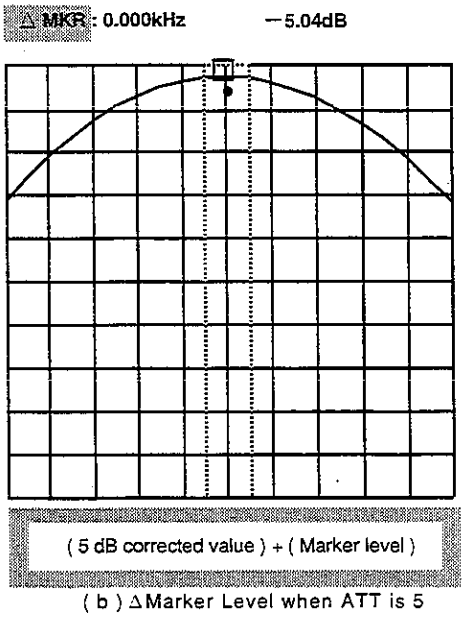
LOG display linearity

Step	Procedure
1	Press the [Preset] key.
2	Operate All Cal.
3	Set the MG3633A to 100 MHz and 0 dBm.
4	Set the MN510C to 0 dB.
5	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 10 kHz Reference Level ..... 0 dBm Attenuator ..... 10 dB RBW ..... 3 kHz VBW ..... 300 Hz
6	Press the [→ CF] key to set the spectrum waveform peak to the center of the screen.
7	Adjust the MG3633A output level so that the marker level reading is 0.0 dBm.
8	Press the [Marker] key sequentially to set the marker to Δ marker after the sweep is completed.

Step	Procedure
9	As shown on Fig. (b), read the level of the current marker when ATT is set at 5dB. An error is determined as calibrated ATT 5 dB value + Δ marker level.
10	Add a marker level corresponding to the calibrated ATT value when ATT is set as 10 to 90 DB (with 5 dB steps) and determine the error.



(a) Reference Point Setting



(b) ΔMarker Level when ATT is 5

Log Display Linearity (10 dB / div)

ATT setting (dB)	A	B	Error (dB)=A+B
	ATT calibration value (dB)	△marker level (dB)	
0	0 (reference)	0 (reference)	0 (reference)
5			
10			
15			
20			
25			
30			
35			
40			
45			
50			
55			
60			
65			
70			
75			
80			
85			
90			

Frequency response

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

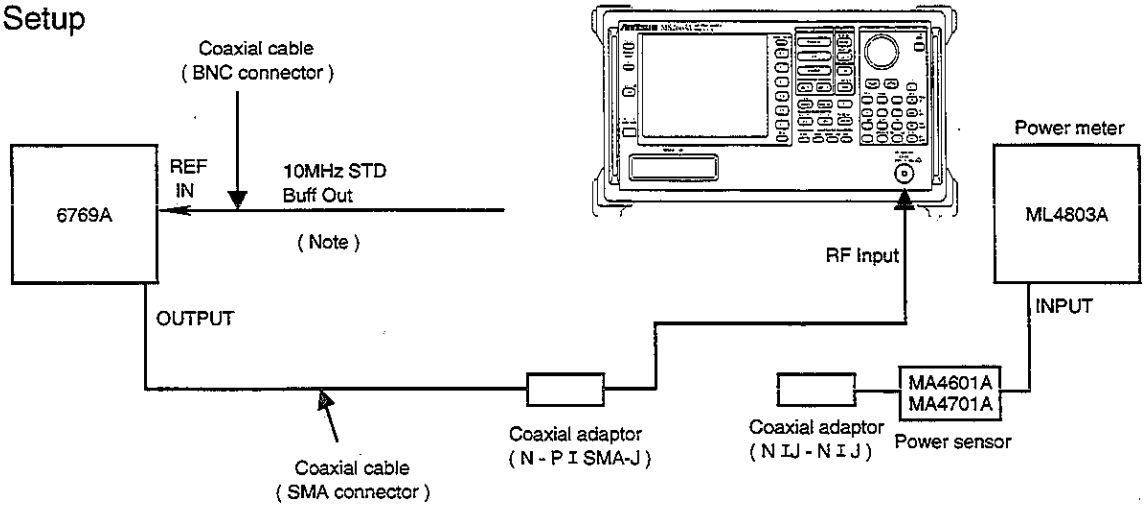
(1) Specifications

- Frequency response:
  - MS2651A/2661A — At 100 MHz, input ATT 10 dB and temperature range 18 to 28°C
    ± 0.5 dB (100 kHz to 3 GHz)
  - MS2653A/2663A
    ± 0.5 dB (100 kHz to 3.2 GHz, band 0, based on 100 MHz, input attenuator: 10 dB, temperature range: 18 to 28 °C)
    ± 1.5 dB (9 to 100 kHz, band 0, based on 100 MHz, input attenuator: 10 dB, temperature range: 18 to 28 °C)
    ± 1.5 dB (3.1 to 8.1 GHz, band 1-/1+, based on 100 MHz, input attenuator: 10 dB, temperature range: 18 to 28 °C)
    ± 1.0 dB (100 kHz to 3.2 GHz, band 0, input attenuator: 10 to 50 dB)
    ± 3.0 dB (3.1 to 8.1 GHz, band 1-/1+, input attenuator: 10 to 50 dB)
    * For band 1- and 1+, after the preselector is tuned.....

(2) Test instruments

- Signal generator: Wiltron 6769A
- Power meter: ML4803A
- Power sensor: MA4601A (For the MS2651A/2661A)
  MA4701A (For the MS2653A/2663A)

(3) Setup



(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

Frequency Response Test

(4) Precautions

This test should be performed at an ambient temperature of 10° to 28℃ after allowing the instrument to warm up for 60 minutes or more.

(5) Procedure

(a) Calibration of signal-generator 6769A

Step	Procedure
1	Set the 6769A as shown below: OUTPUT FREQ ..... 100 MHz OUTPUT LEVEL ..... −10 dBm
2	Connect the 6769A output to the power sensor input with a coaxial cable.
3	Read the power meter display.
4	Change the 6769A output frequency as shown in the tables on the next page and read the power meter display with level at 100 MHz as reference. This data is the calibration data.

(b) Readout of measured amplitude deviation (frequency response)

Step	Procedure
1	Connect the 6769A OUTPUT to the spectrum analyzer RF Input with a coaxial cable.
2	Press the spectrum analyzer [Preset] key.
3	Perform all calibration.
4	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 200 kHz Reference Level ..... −10 dBm
5	Press the [→ CF] key.
6	Set the marker mode to delta marker.
7	Set the spectrum analyzer center frequency as shown in the tables on the next page, then obtain the deviation from the formula below by reading the delta marker level at each frequency. Deviation = Delta marker level reading −Measurement frequency calibration value For Band 1- and 1+, the preselector is peaked. (See Chapter 8 of Vol.2, "Detailed Panel Operation."

Frequency Response

Frequency	Calibration value (dBm)	Marker level (dB)	Deviation (dB)
100 MHz	0 dB (reference)	0 dB (reference)	0 dB (reference)
200 MHz			
500 MHz			
1 GHz			
1.5 GHz			
2 GHz			

Frequency Response (Band 0)

Frequency	Calibration value (dBm)	Marker level (dB)	Deviation (dB)
100 MHz	0 dB (reference)	0 dB (reference)	0 dB (reference)
200 MHz			
500 MHz			
1 GHz			
1.5 GHz			
2 GHz			
3 GHz			

Frequency Response (Band 1-)

Frequency	Calibration value (dBm)	Marker level (dB)	Deviation (dB)
3.1 GHz			
4 GHz			
5 GHz			
6 GHz			
6.5 GHz			

Frequency Response (Band 1+)

Frequency	Calibration value (dBm)	Marker level (dB)	Deviation (dB)
6.5 GHz			
7 GHz			
7.5 GHz			
8 GHz			

Reference level accuracy

Here the absolute amplitude level at only 100 MHz is tested. Confirm the level accuracy after inputting an SG output (calibrated by a standard power meter) to the MS2650/MS2660 series.

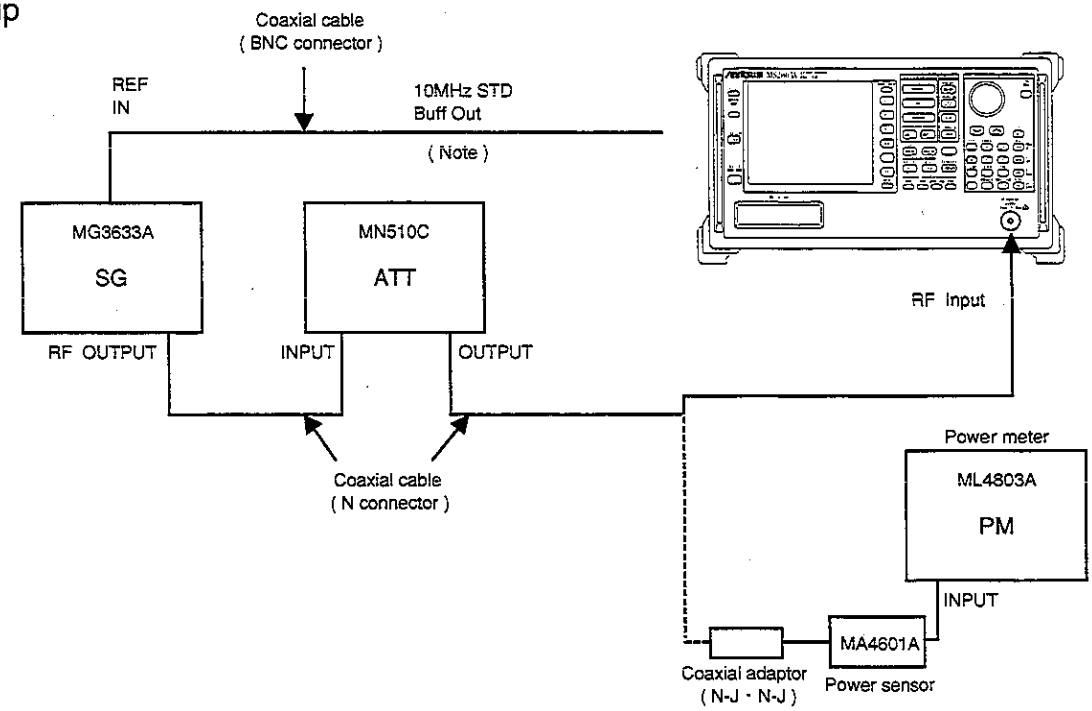
(1) Specifications

- Reference level accuracy: At 100 MHz frequency and 2 MHz span after automatic calibration (Resolution bandwidth, video bandwidth and sweep time set to AUTO)
  - MS2651A/2661A
    ≦ ± 0.3 dB (0 to − 49.9 dBm)
    ≦ ± 0.75 dB (− 69.9 to − 50 dBm, 0.1 to + 30 dBm)
    ≦ ± 1.5 dB (− 80 to − 70 dBm)
  - MS2653A/2663A
    ≦ ± 0.4 dB (0 to − 49.9 dBm)
    ≦ ± 0.75 dB (− 69.9 to − 50 dBm, 0.1 to + 30 dBm)
    ≦ ± 1.5 dB (− 80 to − 70 dBm)

(2) Test instruments

- Signal generator: MG3633A
- Attenuator: MN510C
- Power sensor: MA4601A
- Power meter: ML4803A

(3) Setup



Reference Level Accuracy Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

(4) Precautions

1) Set the resolution bandwidth, video bandwidth and sweep time to Auto.
2) This test should be performed after warming up this instrument for 60 minutes or more.

(5) Procedure

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Connect the attenuator OUTPUT to the power sensor input.
4	Set the SG frequency to 100 MHz and adjust the SG level so that the power meter indication is 0 dBm. At this time, set the attenuator to 0 dB.
5	Connect the attenuator OUTPUT to the spectrum analyzer RF Input connector.
6	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 2 MHz Reference Level ..... 0 dBm
7	Press the [→ CF] to move the peak point of the spectrum waveform to the center of the screen.
8	Read the marker level.

Step	Procedure

9 Change the attenuator in 10 dB steps, set the reference level as shown in the table below and read the marker level each time.

Reference level setting	Marker level value	Calibrated attenuation value	Error
0 dBm			
−10 dBm			
−20 dBm			
−30 dBm			
−40 dBm			
−50 dBm			
−60 dBm			
−70 dBm			
−80 dBm			

10 Find the error from the following equation.

Error = marker level value — reference level set value — calibrated attenuation value

Average noise level

The internal noise distributed evenly in proportion to the resolution bandwidth over the whole measurement frequency band is called the average noise level.

(1) Specifications

- Average noise level: At 1 kHz resolution bandwidth, 1 Hz video bandwidth, and 0 dB input attenuator:

  - MS2661A

    ≦ − 115 dBm (1 MHz to 1 GHz)

    ≦ − 115 dBm + f [GHz] dB (1 GHz ≦)

  - MS2651A

    ≦ − 110 dBm (1 MHz to 1 GHz)

    ≦ − 110 dBm +f [GHz] dB (1 GHz ≦)

  - MS2663A

    ≦ − 115 dBm (1 MHz to 1 GHz)

    ≦ − 115 dBm + 1.5 f GHz] dB (1 to 3.1 GHz, Band 0)

    ≦ − 115 dBm + 0.5 f [GHz] dB (3.1 to 8.1 GHz, Band 1)

  - MS2653A

    ≦ − 110 dBm (1 MHz to 1 GHz)

    ≦ − 110 dBm + f [GHz] dB (1 to 3.1 GHz, Band 0)

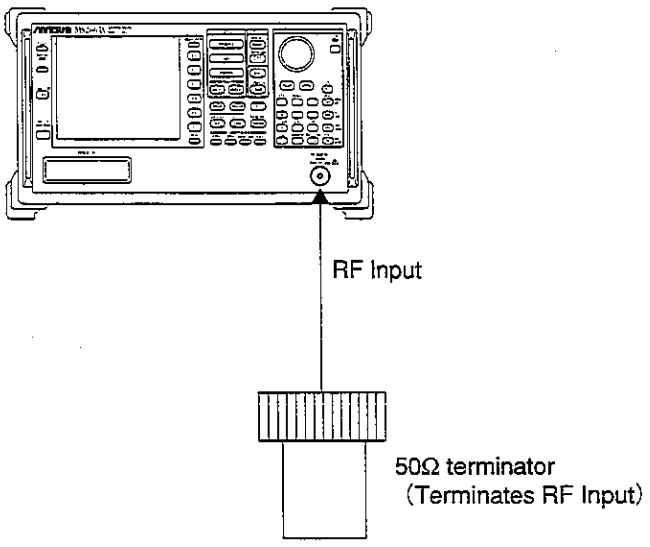
    ≦ − 110 dBm + 0.5 f [GHz] dB (3.1 to 8.1 GHz, Band 1)

(2) Test instruments

- 50 Ω terminator: MP752A (For the MS2651A/2661A)

  WILTRON 28KF50(For the MS2653A/2663A)

(3) Setup



Average Noise Level Test

(4) Procedure

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Terminate the RF Input with a 50 Ω terminator.
4	Set the spectrum analyzer as shown below: Start Freq ..... 1 MHz Stop Freq ..... 1 GHz Reference Level ..... −40 dBm Attenuator ..... 0 dB RBW ..... 30 kHz VBW ..... 3 kHz Detection ..... Sample
5	Press the [Single] key to execute a single sweep.
6	Press the [→ CF] key to set the frequency at the peak level of the spectrum to the center frequency.
7	Press the [Shift] key and then the [Single] key to execute a continuous sweep.
8	Set the spectrum analyzer as shown below : (Time Domain) Span ..... 0 Hz Reference Level ..... −100 dBm RBW ..... 1 kHz VBW ..... 1 Hz
9	Press [Time], Storage, Average and Average Count keys in order and set the average count to 16.
10	Press the Continue key to start the averaging, and wait until the 16-time averaging sweep is completed.
11	Press the [Peak Search] key to execute peak search. At this point, read the level value at the marker.
12	Confirm that the marker reading is less than the specification, shown in the table on the next page.

Step | Procedure

MS2651A/MS2661A setting		Average noise level	
START FREQ	STOP FREQ	Marker reading	MS2651A/MS2661A specification
1 MHz	1 GHz		−110 dBm/−115 dBm
1 GHz	2 GHz		−109 to −108 dBm/ −114 to −113 dBm

MS2653A/MS2663A setting		Average noise level	
START FREQ	STOP FREQ	Marker reading	MS2653A/MS2663A specification
1 MHz	1 GHz		−115 dBm/−110 dBm
1 GHz	2 GHz		−113.5 dBm to −112 dBm −118.5 dBm to −107 dBm
4 MHz	6 GHz		−113 dBm to −112 dBm −118 dBm to −107 dBm
7 GHz	8 GHz		−111.5 dBm to −111 dBm −106.5 dBm to −106 dBm

13 Repeat steps 4 to 12 while setting Start / Stop Freq from the below table so that the average noise level can be obtained.

Second harmonic distortion

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

The second harmonic level is the highest harmonic displayed on the MS2650/MS2660 series spectrum analyzer. The main point of the test is to apply a signal (with a distortion that is lower than the spectrum analyzer internal harmonic distortion [at least 20 dB below]) to the spectrum analyzer and measure the level difference between the fundamental wave and the second harmonic. If a low-distortion signal source cannot be obtained, apply a low-distortion signal to the spectrum analyzer after passing the signal through a low-pass filter (LPF).

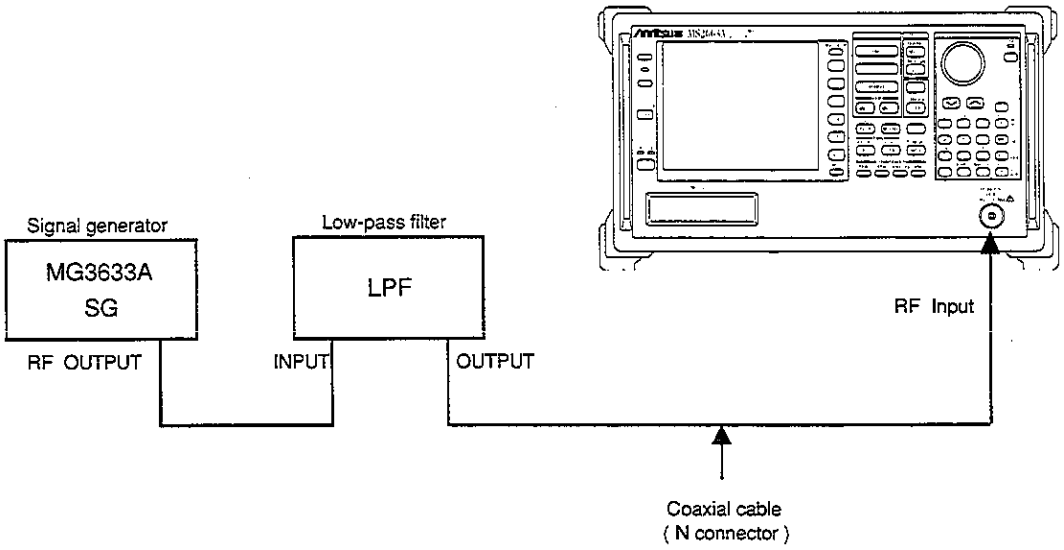
(1) Specifications

- Second harmonic distortion:
  - MS2661A — At mixer input level − 30 dBm:
    ≦ − 60 dBc (input frequency 10 to 200 MHz)
    ≦ − 75 dBc (input frequency 200 to 1500 MHz)
    ≦ − 80 dBc (input frequency 800 to 1000 MHz)
  - MS2651A — At mixer input level − 30 dBm:
    ≦ − 55 dBc (input frequency 10 to 100 MHz)
    ≦ − 60 dBc (input frequency 100 to 1500 MHz)
  - MS2663A — At mixer input level − 30 dBm:
    ≦ − 60 dBc (10 to 200 MHz, Band 0)
    ≦ − 75 dBc (0.2 to 1.3 GHz, Band 0)
    ≦ − 70 dBc (1.3 to 1.55 GHz, Band 0)
    ≦ − 80 dBc (0.8 to1 GHz, Band 0)
    At mixer input level − 20 dBm:
    ≦ − 100 dBc (1.55 to 4.05 GHz, Band 1-/1+)
  - MS2653A — At mixer input level − 30 dBm:
    ≦ − 55 dBc (10 to 100 MHz)
    ≦ − 60 dBc (0.1 to1.55 GHz)
    At mixer input level − 20 dBm:
    ≦ − 100 dBc (1.55 to 4.05 GHz, Band 1-/1+)

(2) Test instruments

- Signal generator: MG3633A
- LPF: With attenuation of 70 dB or more at twice the fundamental frequencies

(3) Setup

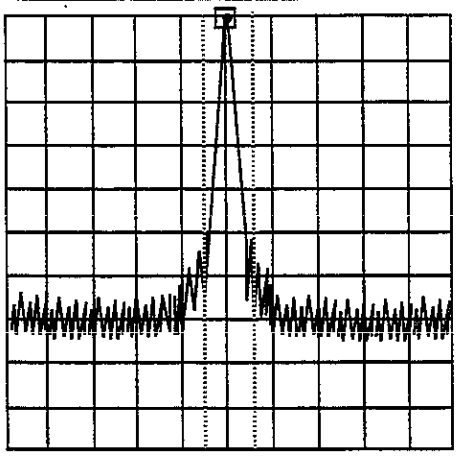


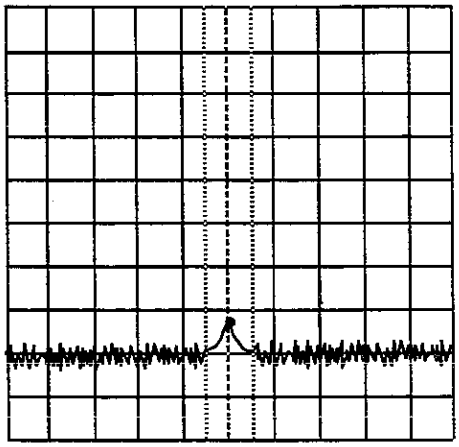
Second Harmonic Distortion Test

(4) Procedure

Step	Procedure
1	Press the [Preset] key.
2	Operate All Cal.
3	Set the LPF cut-off frequency to approx. 12.8 MHz.
4	Set the SG output frequency to 10 MHz and the output level to −30 dBm.
5	Set the spectrum analyzer as shown below: Center Freq ..... 10 MHz Span ..... 10 kHz Reference Level ..... −30 dBm Attenuator ..... 0 dB
6	Adjust the SG output level so that peak of the spectrum waveform is at the REF LEVEL (the top horizontal line of the screen).

Step	Procedure
7	Move the marker to the peak of the spectrum waveform and make the marker the △ marker.
8	Set the center frequency to twice the fundamental wave frequency to display the second harmonic on the screen. The △ marker reading indicates the level difference between the fundamental wave and the second harmonic. If the level difference is 80 dB or more, set the REF LEVEL to −50 dBm. Confirm that the ATT set value is 0 dB.
9	Set the LPF cut-off frequency to approx. 1.2 GHz.
10	Set the SG as follows: OUTPUT FREQ ..... 1 GHz OUTPUT LEVEL ..... −30 dBm
11	Set the spectrum analyzer as follows: Center Freq ..... 1 GHz Span ..... 10 kHz Reference Level ..... −30 dBm Attenuator ..... 0 dB
12	Repeats steps 6 to 8.





Resolution bandwidth (RBW) switching error

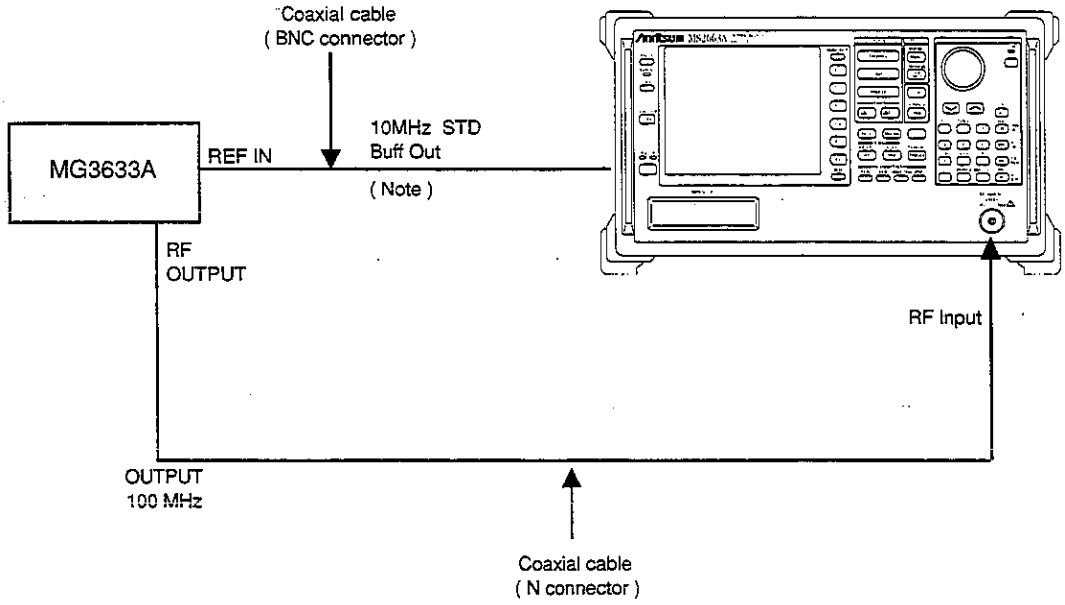
When the resolution bandwidth (RBW) is switched, its level error at the peak point is measured.

(1) Specifications

- Resolution bandwidth switching error: ± 0.3 dB

  ± 0.4 dB (For MS2653A/2663A, RBW=5 MHz)

(2) Setup



Resolution Bandwidth Switching Error Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

(4) Procedure

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Set the signal generator MG3633A as shown below. OUTPUT FREQ ..... 100 MHz OUTPUT LEVEL ..... 0 dBm
4	Set the spectrum analyzer as shown below. Center Freq ..... 100 MHz Span ..... 15 kHz Reference Level ..... 0 dBm RBW ..... 3 kHz
5	Press the [→ CF] key to move the signal spectrum peak to the center.
6	Press [Marker] key in that order to set the marker to Δ marker.
7	Set RBW and SPAN as shown in the table on the next page and measure the level deviation (error) of each RBW by following steps 8 and 9 below.
8	Press [Peak Search] 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.

MS2660/MA2650 series setting		Δ marker reading	Specification
RBW	SPAN		
1 kHz	5 kHz		±0.3 dB
3 kHz	15 kHz	0.0 dB	Reference
10 kHz	50 kHz		±0.3 dB
30 kHz	150 kHz		±0.3 dB
100 kHz	500 kHz		±0.3 dB
300 kHz	1.5 MHz		±0.3 dB
1 MHz	5 MHz		±0.3 dB
5 MHz	10 MHz		±0.3 dB (MS2651A/2661A) ±0.4 dB (MS2653A/2663A)

Input attenuator switching error

At this point, measure the switching error when the amount of attenuation in the RF input section is switched. When the input attenuator is switched, IF-section step-amplifier gain is switched. To keep this step-amplifier gain constant, the reference level is switched according to the amount of input attenuator attenuation.

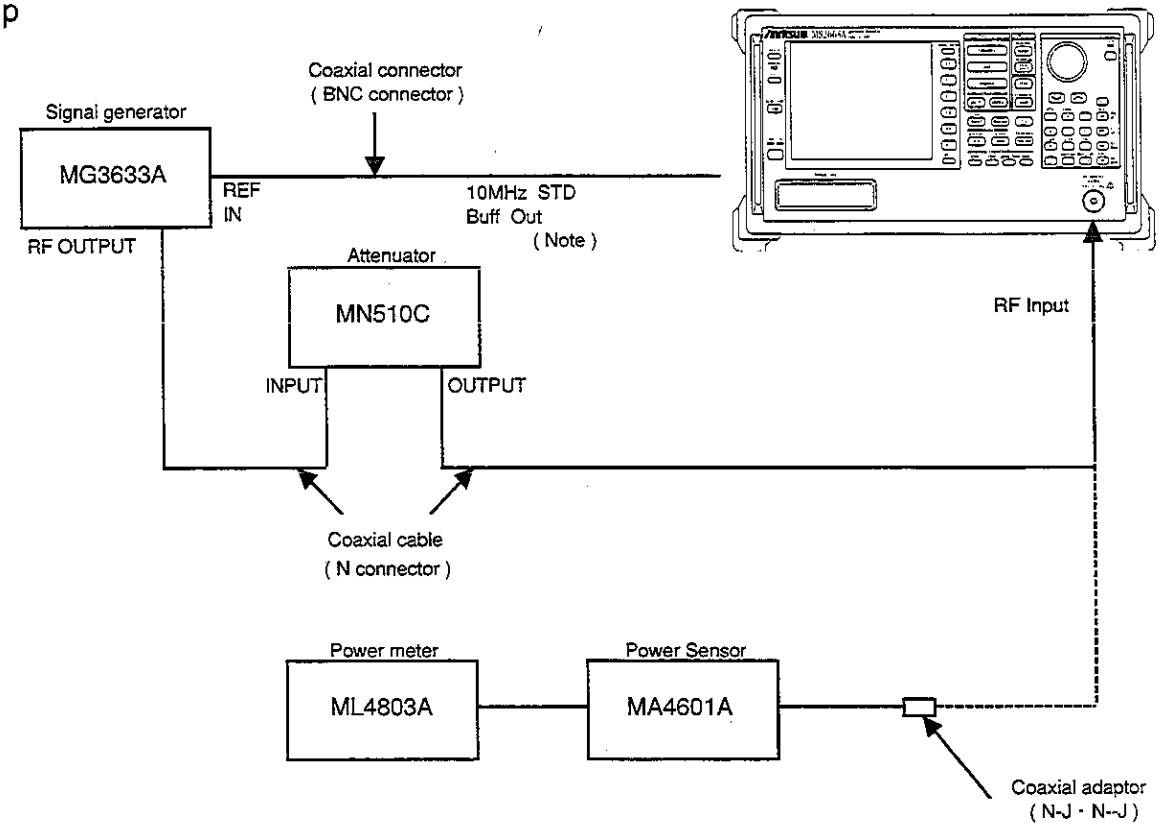
(1) Specifications

- Input attenuator switching error: ± 0.3 dB (at 0 to 50 dB, frequency 100 MHz and input ATT 10 dB)

(2) Test instruments

- Signal generator: MG3633A
- Attenuator: MN510C
- Power meter: ML4803A
- Power sensor: MA4601A

(3) Setup



Input Attenuator Switching Error Test

(Note) If there is no buffer output for the reference oscillator (Option 01) on the rear panel, input a reference signal from an external 10 MHz frequency standard to the main body and signal generator.

(4) Procedure

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Set the spectrum analyzer as shown below: Center Freq ..... 100 MHz Span ..... 200 kHz
4	Set the signal generator MG3633A as shown below: OUTPUT FREQ ..... 100 MHz OUTPUT LEVEL ..... −10 dBm
5	Set the amount of attenuation of the attenuator MN510C to 0 dB.
6	Connect the output of the attenuator MN510C to the power meter via coaxial cable.
7	Adjust the signal-generator output level so that the indicated value of the power meter is −10.0 dBm.
8	Connect the coaxial cable of the attenuator output to the spectrum analyzer RF Input.
9	Press the [→ CF] key.
10	Set the reference level to −10 dBm and attenuation to 50 dB.
11	Read the marker level.
12	Set Reference Level, ATT of this device and the external ATT as shown in the table on the next page, and read the level of each marker.
13	Find the error by the formula below: Error = marker level value − Reference Level − attenuator calibration value
14	Find the deviation by the formula below: Deviation = Error − error when ATT at 10 dB Confirm that the deviation is within ±0.3 dB.

Spectrum analyzer setting		Attenuator setting	Calibration value of attenuator	Marker level value	Error	Deviation
REF LEVEL	ATT					
− 10 dBm	50 dB	0 dB	dB	dBm	dB	dB
− 20 dBm	40 dB	10 dB	dB	dBm	dB	dB
− 30 dBm	30 dB	20 dB	dB	dBm	dB	dB
− 40 dBm	20 dB	30 dB	dB	dBm	dB	dB
− 50 dBm	10 dB	40 dB	dB	dBm	dB	0 dB (reference)
− 60 dBm	0 dB	50 dB	dB	dBm	dB	dB

Sweep time and time span accuracy

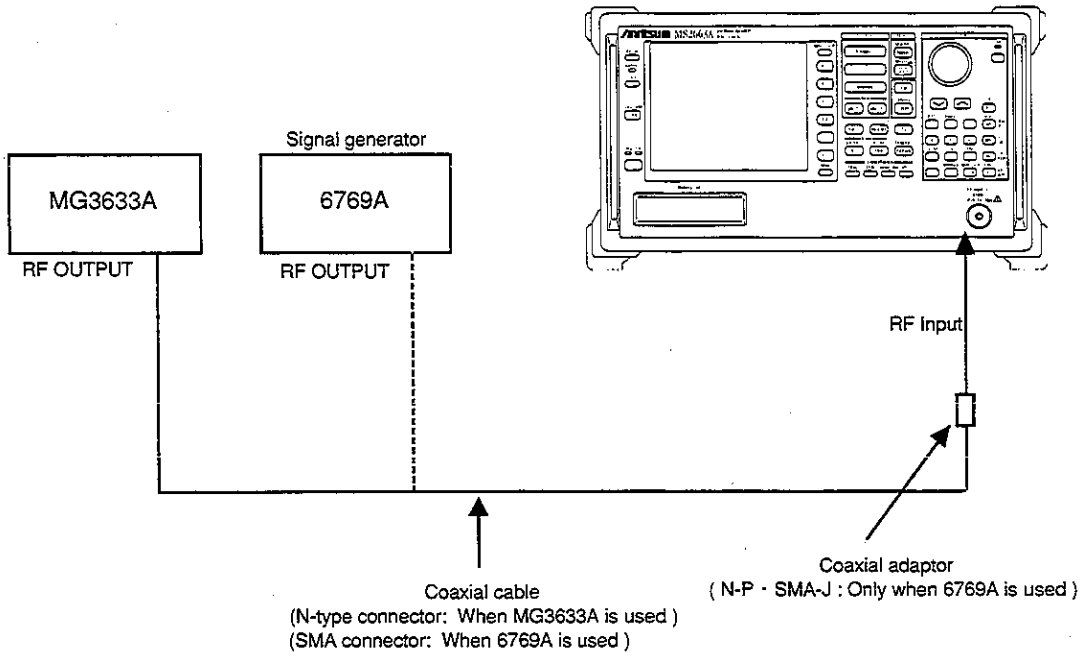
(1) Specifications

- Sweep time accuracy: ± 15% (20 msec to 100 sec)
  ± 45% (110 sec to 1000 sec)
- Time span accuracy: ± 1%

(2) Test instruments

- Signal generator: MG3633A
  Wiltron 6769A

(3) Setup



Sweep Time and Time Span Accuracy

(4) Procedure

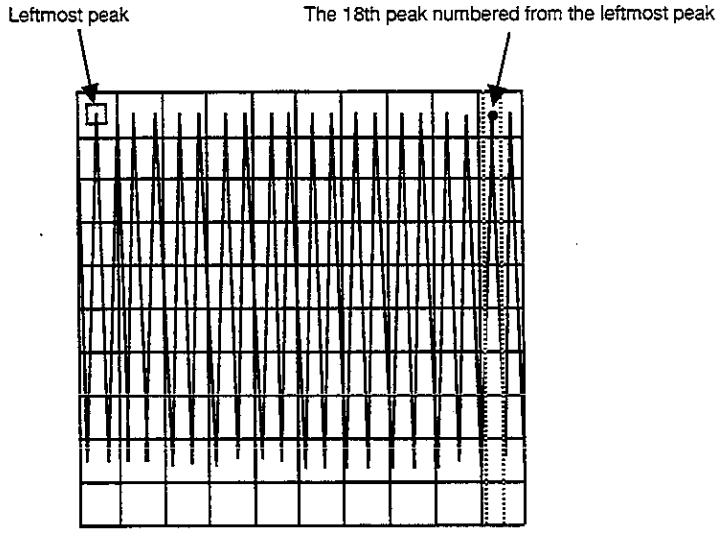
(a) Sweep Time

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Connect the MG3633A signal generator with the spectrum analyzer as shown in the setup diagram.
4	Set the spectrum analyzer as shown below: CENTER FREQ ..... 100 MHz SPAN ..... 1 KHz SWP TIME ..... 20 msec RBW ..... 1 MHz VBW ..... 1 MHz
5	Set the MG3633A as shown below: OUTPUT FREQ ..... 100 MHz OUTPUT LEVEL ..... −16 dBm MODULATION ..... AM (INT) 90% MODULATION FREQ ..... 1 kHz
6	Press the [→ RLV] key.
7	Set the scale to Linear.
8	Press the [Single] key, then wait until a single sweep execution is completed.
9	Set the marker zone width to 5 Hz (Zone Width = 5 Hz).
10	Move the marker to the left of the screen using the knob and set the zone marker on the left most peak of the sine wave.
11	Setting the marker mode to Δ (delta), move the current marker to the right using the knob. Then set the zone marker to the 18th peak from the left most sine wave peak on the screen.
12	Read the time display of the Δ marker, which corresponds to 90% of the Sweep Time. Obtain the SWP TIME by the following equation. $\text{SWP TIME} = \text{Setting SWP TIME} \times \frac{\text{maker reading}}{\Delta\ 1000\ (\text{Hz})}$

Step	Procedure

13 Measure at each setting shown in the table below according to steps 8 to 12.

Spectrum analyzer Setting SWP TIME	MG3633A AM modulation frequency	Spectrum analyzer SWP TIME	90% of specification min / max
20 msec	1 kHz		15.3 msec / 20.7 msec
200 msec	100 Hz		153 msec / 207 msec
2 sec	10 Hz		1.53 sec / 2.07 sec
20 sec	1 Hz		15.3 sec / 20.7 sec
200 sec	0.1 Hz		99 sec / 261 sec



(b) Time span

Step	Procedure
1	Perform test procedure steps 1 to 8 on the preceding paragraph (a). However, set MODULATION FREQ of the MG3633A to 100 Hz.
2	Set the display mode to Time.
3	Set Time Span to 20 msec.
4	Perform steps 8 to 13 of the test procedure on the preceding paragraph (a).

Spectrum analyzer time span	MG3633A AM modulation frequency	Spectrum analyzer Δ marker reading	90% of specification min / max
20 msec	1 kHz		17.82 msec / 18.12 msec
200 msec	100 Hz		178.2 msec / 181.8 msec
2 sec	10 Hz		1.782 sec / 1.818 sec
20 sec	1 Hz		17.82 sec / 18.18 sec
200 sec	0.1 Hz		178.2 sec / 181.8 sec

Tracking generator(TG) output level accuracy

The output level of the Tracking Generator(TG, Option 20) can be easily tested by inputting the TG output signal to the RF Input connector of the Spectrum analyzer.
Here, an accurate method to test the TG output level by using a power meter, is described below.

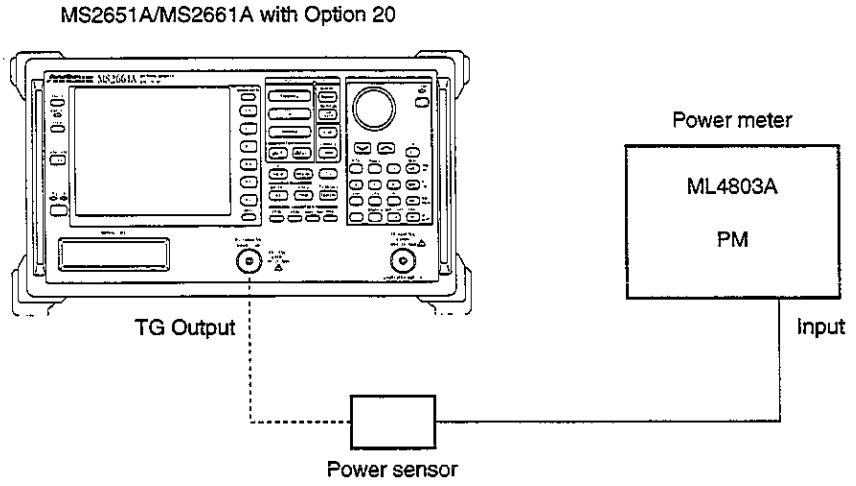
(1) Specifications

Output level range:	0to − 60dBm
Output level accuracy:	≦± 1.0 dB(at frequency 100 MHz, output level 0 dBm)
Output level flatness:	≦± 1.5 dB(at output level 0 dBm, referenced to 100 MHz)
Output level linearity:	≦± 1.0 dB(output level 0 to − 30 dBm)
	≦± 2.0 dB(output level − 30 to − 60 dBm)
	(referenced to 0 dBm)

(2) Test instrument

- Power meter: ML4803A
- Power sensor: MA4601A, MA4602A

(3) Setup



TG Output Level Accuracy Test

(4) Procedure

(a) Calibrating ML4803A Power Meter

Step	Procedure
1	Warm-up the ML4803A, then zero-adjust the ML4803A. (Note: Don't connect anything to the power sensor.)
2	Connect the power sensor to the CAL OUTPUT of the ML4803A. Press the [ON] key. After conforming the measured value to be stabilized, press the [ADJ] key for calibration.

(b) Measuring TG output level accuracy

Step	Procedure
1	Press the [Preset] key.
2	Connect the power sensor to the TG Output.
3	Set the spectrum analyzer as shown below: Center Freq ---------- 100 MHz Span ---------- 10 MHz
4	Set the TG output level to 0 dBm, and ON.
5	Measure the TG output level with the power meter.
6	Changing the Center Freq of the spectrum analyzer as shown in the table on the next page, repeat the steps 3 to 5 above.
7	Changing the output level of the spectrum analyzer as shown in the table on the next page, repeat the steps 3 to 6 above.

TG Output Level Accuracy Test

Output level (dBm)	Frequency(Hz)							
	100k	1M	10M	50M	100M	1G	2G	3G
0								
−1～−9								
−10								
−20								
−30								
−40								
−50								

Service

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

(a) Model name and serial number on rear panel

(b) Fault description

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

SECTION 7

STORAGE AND TRANSPORTATION

This section describes the long-term storage, repacking and transportation of the MS2650/MS2660 series as well as the regular care procedures and the timing.

TABLE OF CONTENTS

Cleaning Cabinet 7-3

Storage Precautions 7-4

- Precautions before storage 7-4
- Recommended storage precautions 7-4

Repacking and Transportation 7-5

- Repacking 7-5
- Transportation 7-5

SECTION 7
STORAGE AND TRANSPORTATION

Cleaning Cabinet

Always turn the spectrum analyzer 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 neutral cleaning liquid if the instrument is very dirty or before long-term storage.

  After insuring that the cabinet has been thoroughly dried, use a soft, dry cloth for wiping off.
- If loose screws 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 MS2650/MS2660 series SPECTRUM ANALYZER.

Precautions before storage

(1) Before storage, wipe dust, finger-marks, and other dirt off the spectrum analyzer.

(2) Avoid storing the spectrum analyzer where:

1) It may be exposed to direct sunlight or high dust levels.
2) It may be exposed to high humidity.
3) It may be exposed to active gases.
4) It may be exposed to extreme temperatures (> 40℃ or > 70℃) or high humidity (≧ 90%).

Recommended storage precautions

The recommended storage conditions are as follows:

- Temperature ..... 0 to 30°C
- Humidity ..... 40% to 80%
- Stable temperature and humidity over 24-hour period

Repacking and Transportation

The following precautions should be taken if the MS2650/MS2660 series SPECTRUM ANALYZER must be returned to Anritsu Corporation for servicing.

Repacking

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

(1) Wrap the spectrum analyzer in a plastic sheet or similar material.
(2) Use a cardboard, wooden box, or aluminum case which allows shock-absorbent material to be inserted on all sides of the equipment.
(3) Use enough shock-absorbent material to protect the spectrum analyzer from shock during transportation and to prevent it from moving in the container.
(4) Secure the container with packing straps, adhesive tape or bands.

Transportation

Do not subject the spectrum analyzer to severe vibration during transport. It should be transported under the storage conditions recommended in paragraph 7.2.

APPENDIXES

TABLE OF CONTENTS

APPENDIX A FRONT AND REAR PANEL LAYOUT A-1

APPENDIX B BLOCK DIAGRAM B-1

APPENDIX A
FRONT AND REAR PANEL LAYOUT

This appendix shows the front and rear panel layout.

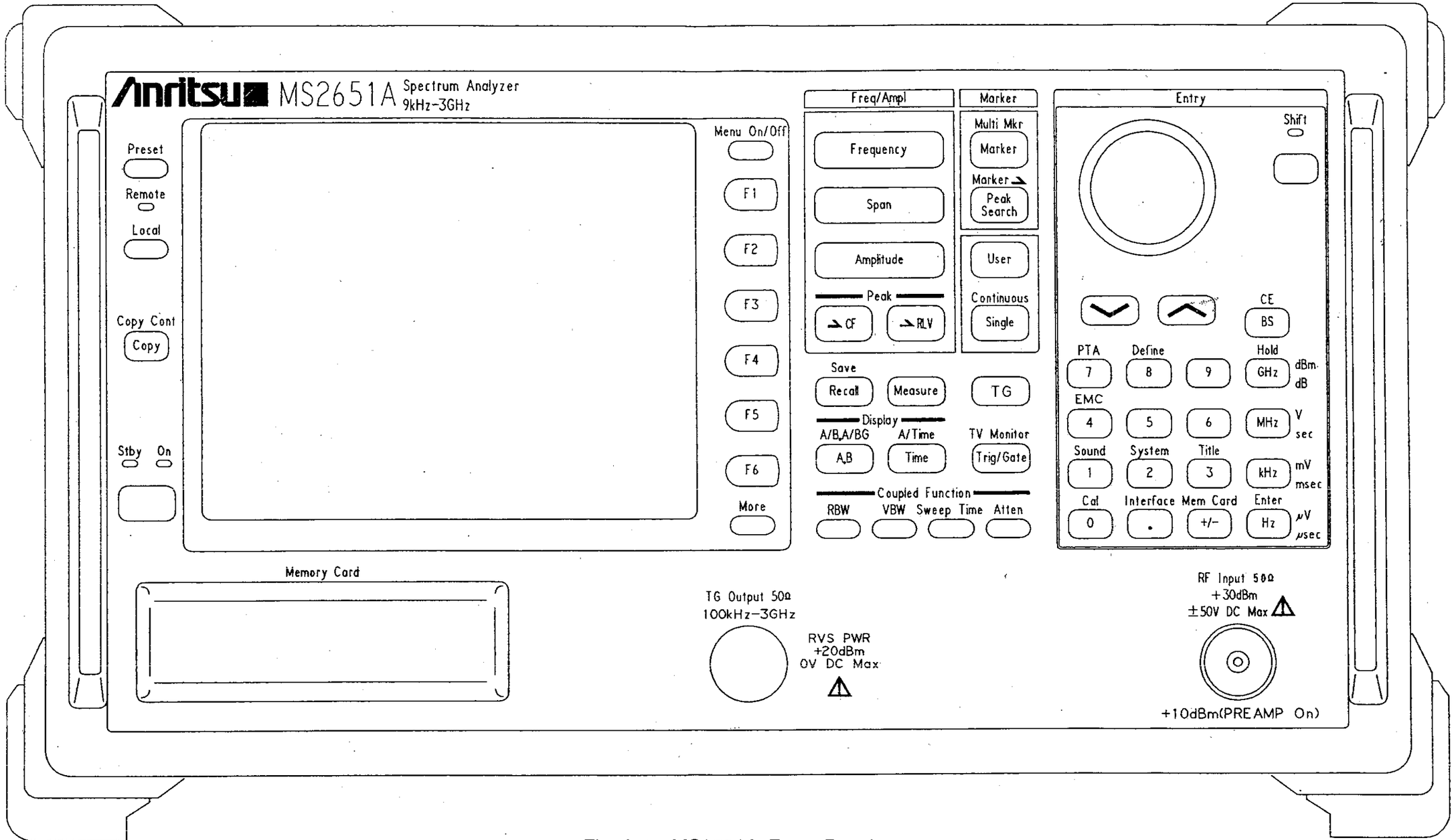


Fig. A-1 MS2651A Front Panel

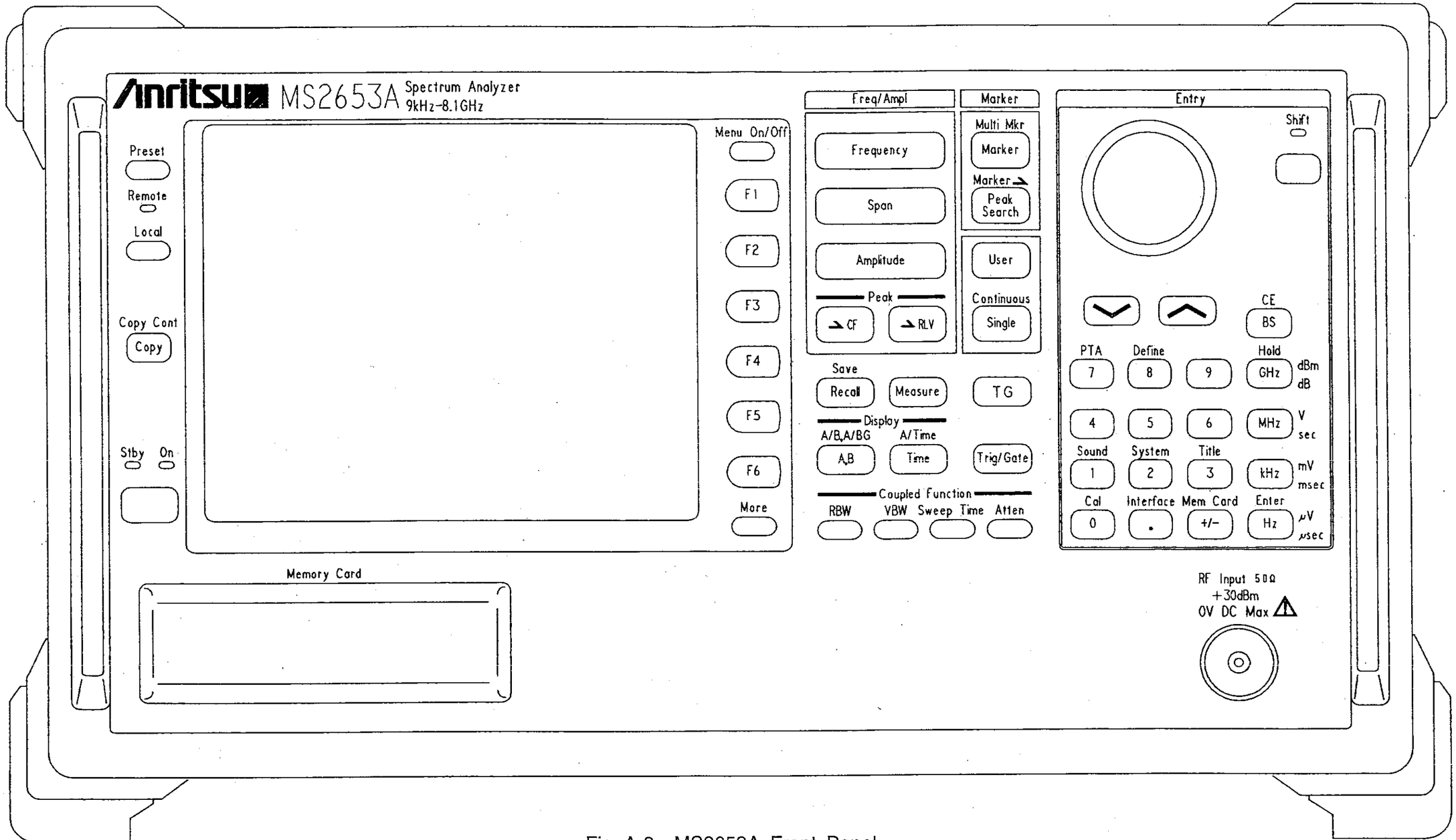


Fig. A-2 MS2653A Front Panel

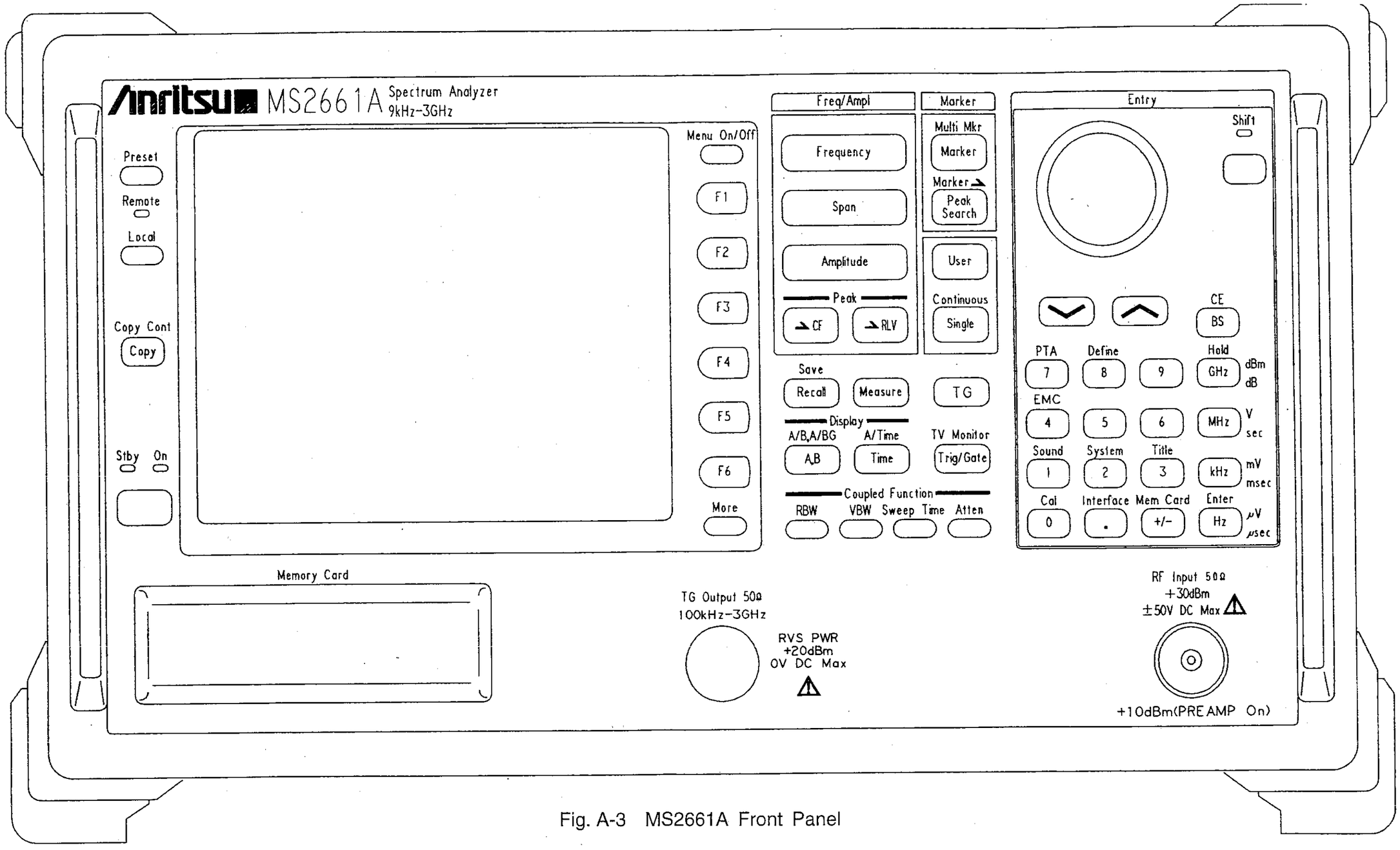


Fig. A-3 MS2661A Front Panel

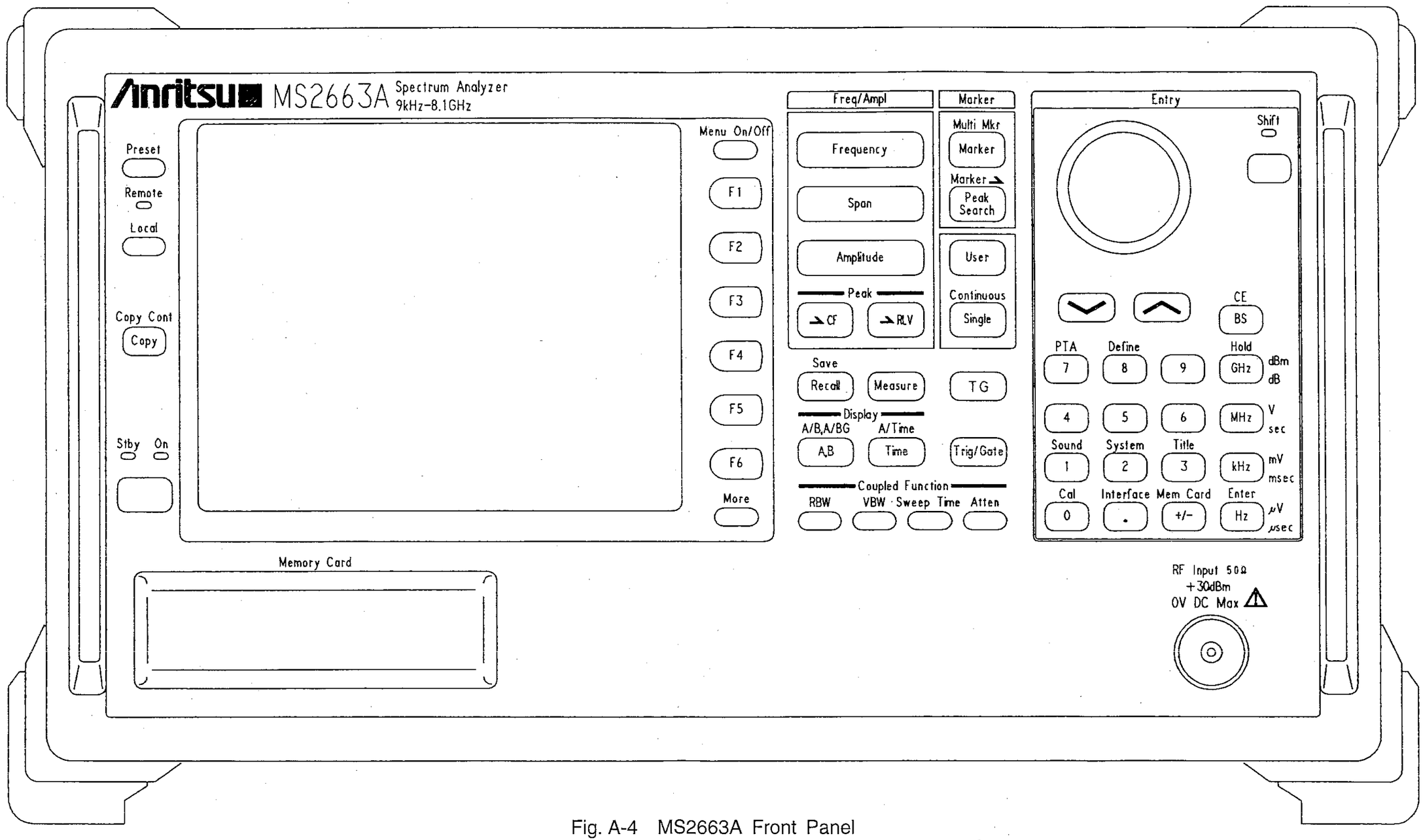
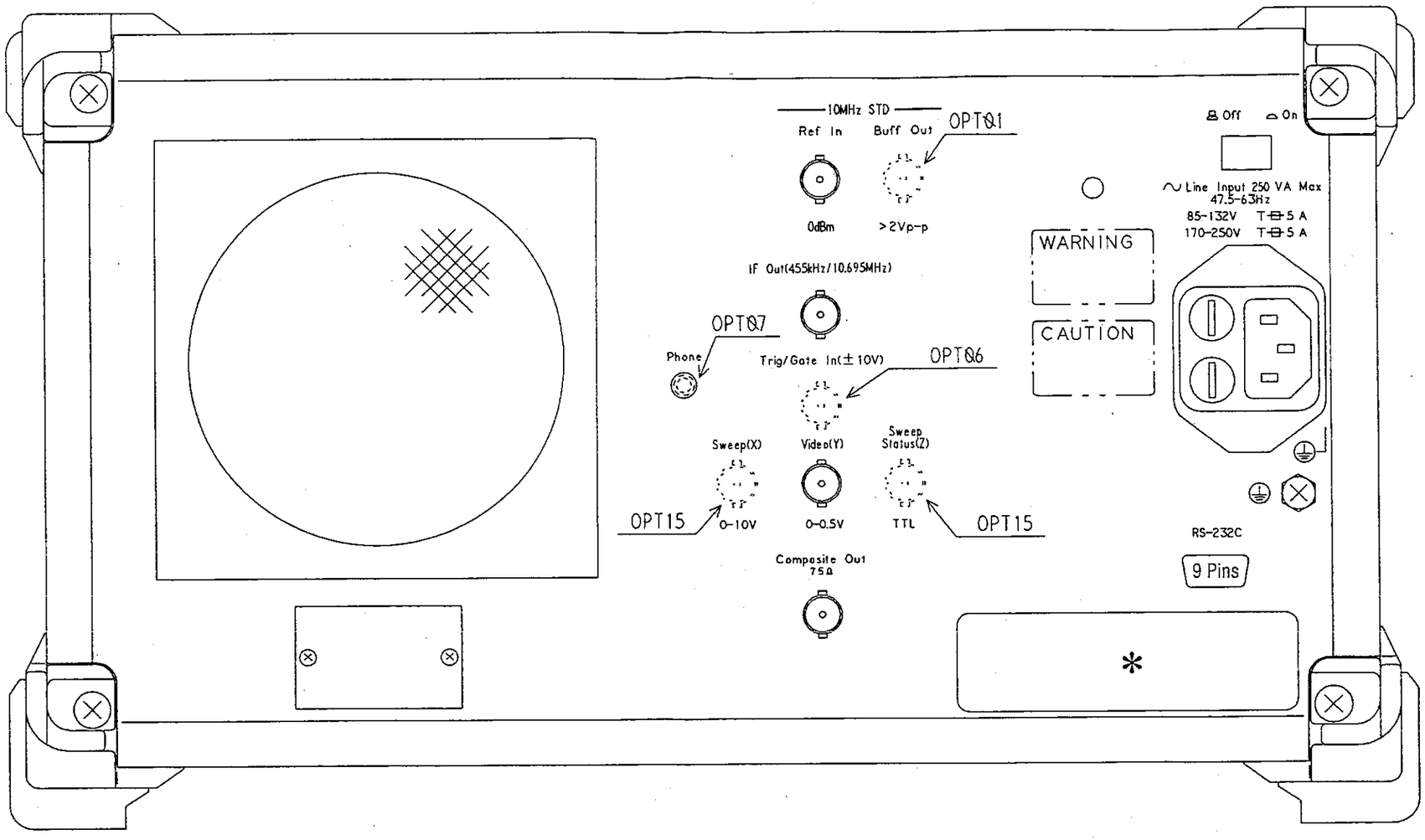
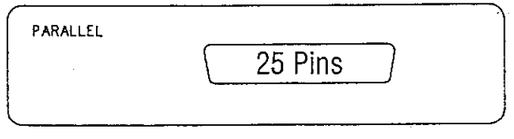


Fig. A-4 MS2663A Front Panel



* : For OPT10



* : For OPT9

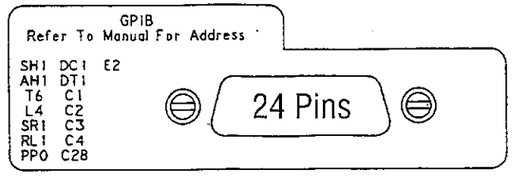


Fig. A-5 Rear Panel (1/2)
(Common to All types)

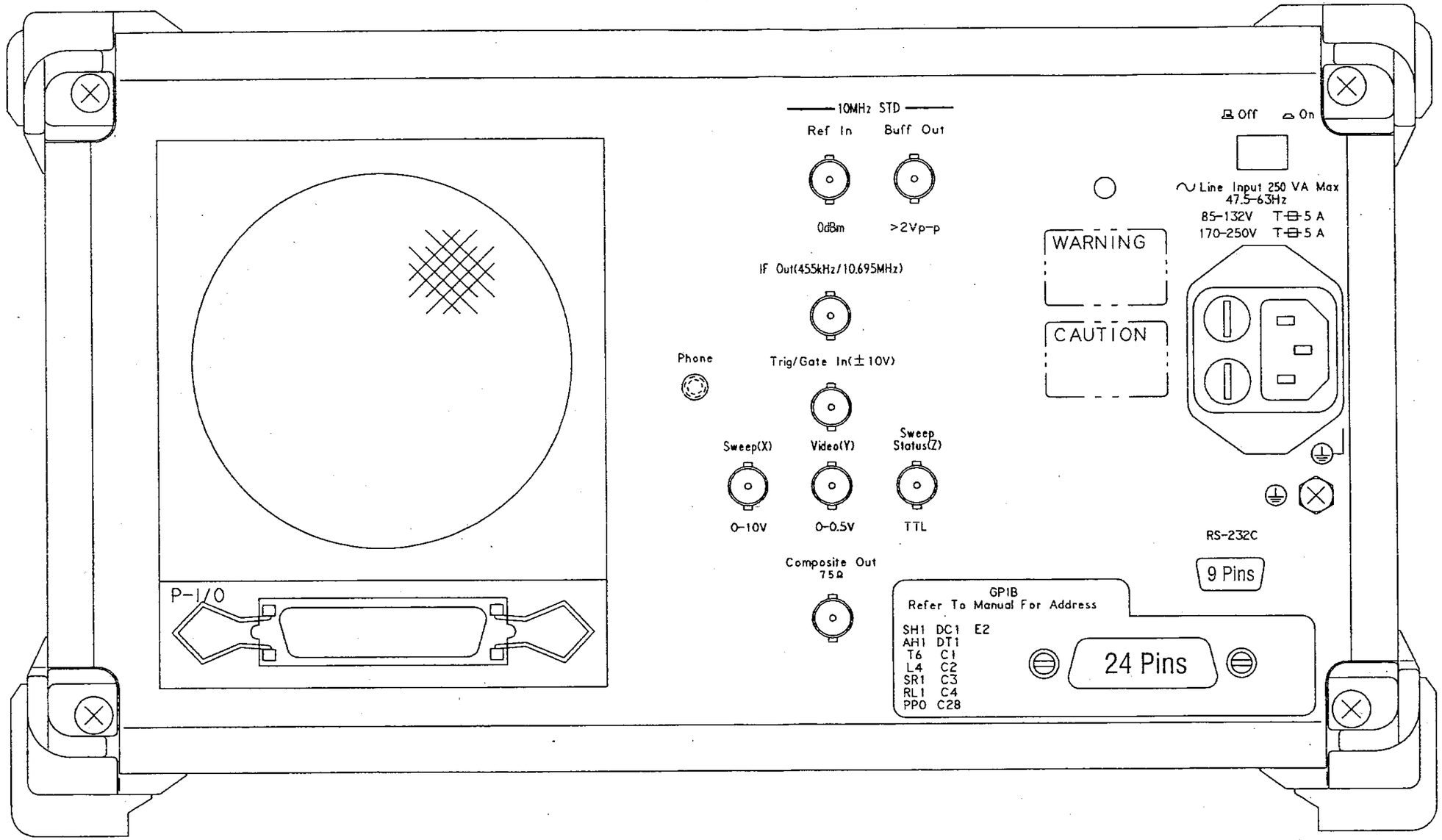


Fig. A-5 Rear Panel (2/2)
(Common to All types)

APPENDIX B
BLOCK DIAGRAM

This appendix shows the Block Diagram of the MS2651A/MS2661A and MS2653A/MS2663A.

APPLICATION

REVISIONS

DC Coupling

RF INPUT

RF INPUT

RF ATTN

ATT:0 to 70dB (10dB step)

50Ω

AMP

GAIN:25dB

3GHz CONVERTER

0-3GHz CONVIN

~3GHz

MIX

4116.695MHz

MIX

118.7MHz-1F

1st LOCAL

4.1-6.6GHz

YTO

4GHz

VCO

SAMPLING PD

SAMPLER

PFD

CAL OSC

CAL ATT

625kHz

f/16

dB

ATT:0-95dB

18MHz

94-106MHz

11-14MHz

SCAN

106MHz

TRACKING GENERATOR

RF ATTN

TG OUTPUT

dB

ATT:0 to 60dB (10dB step)

MIX

4116.7MHz

DRO

COMP

D/A

SAMPLER

PFD

LOCAL

MS2661A

94-106MHz

VCO

MIX

PFD

113-137MHz

VCO

MIX

PFD

f/10

118-148MHz

VCO

AFC

MIX

PFD

SPAN 1MHz

SPAN 1MHz

SPAN ATT

SCAN

SCAN

EXT REF IN

18MHz

PD

106MHz VCXO

OCXO 18MHz

(OPTION)

BUFFERED OUT (OPTION)

106MHz

106MHz

18MHz

18MHz

*MS2651A

94-106MHz

f/2

188-212MHz

VCO

MIX

PD

18MHz

DEP

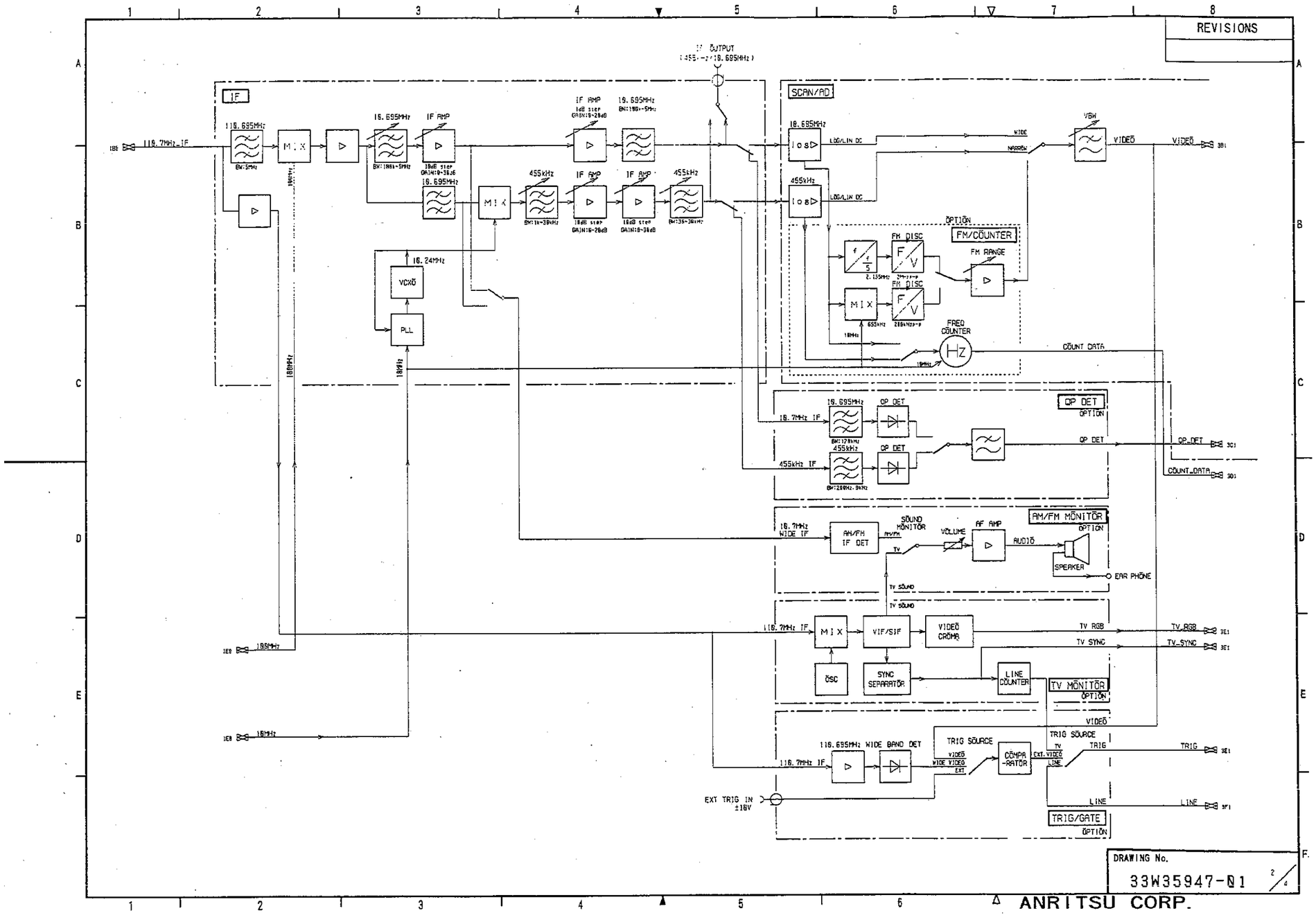
QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

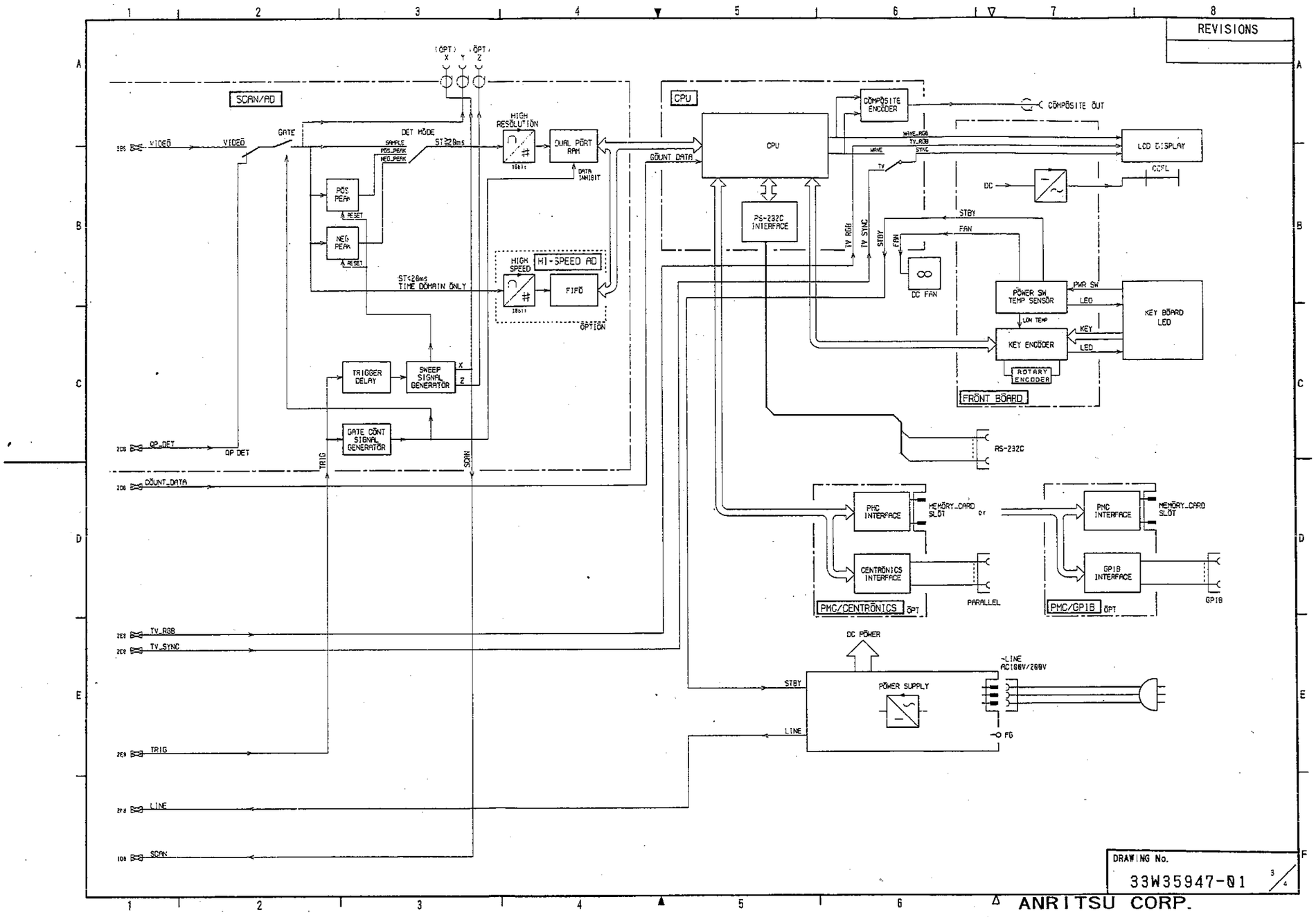
CHECKED BY	DRAWN BY	SCALE	
APPROVED BY	DESIGNED BY	:	

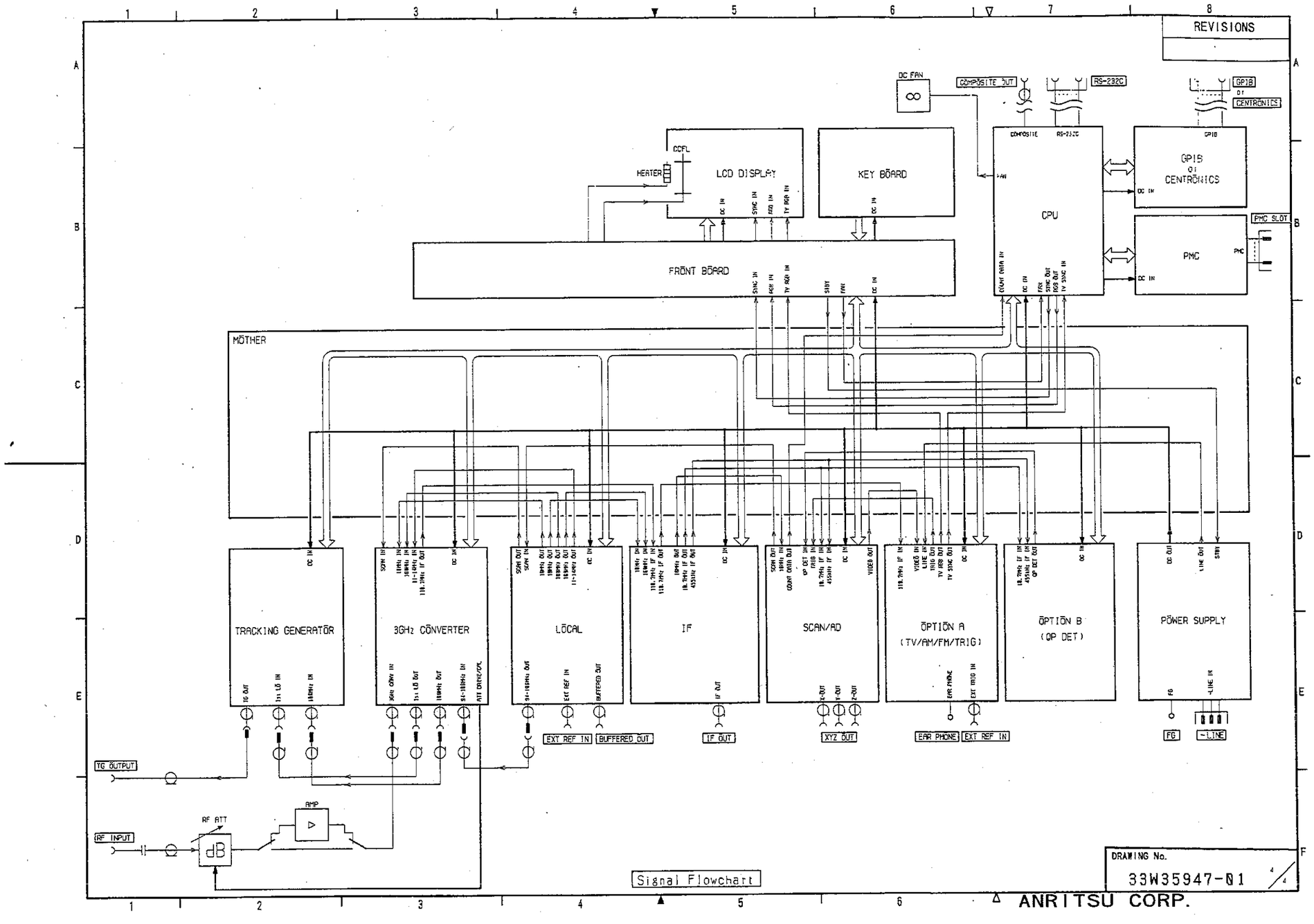
TITLE MS2651A/MS2661A Circuit Diagram

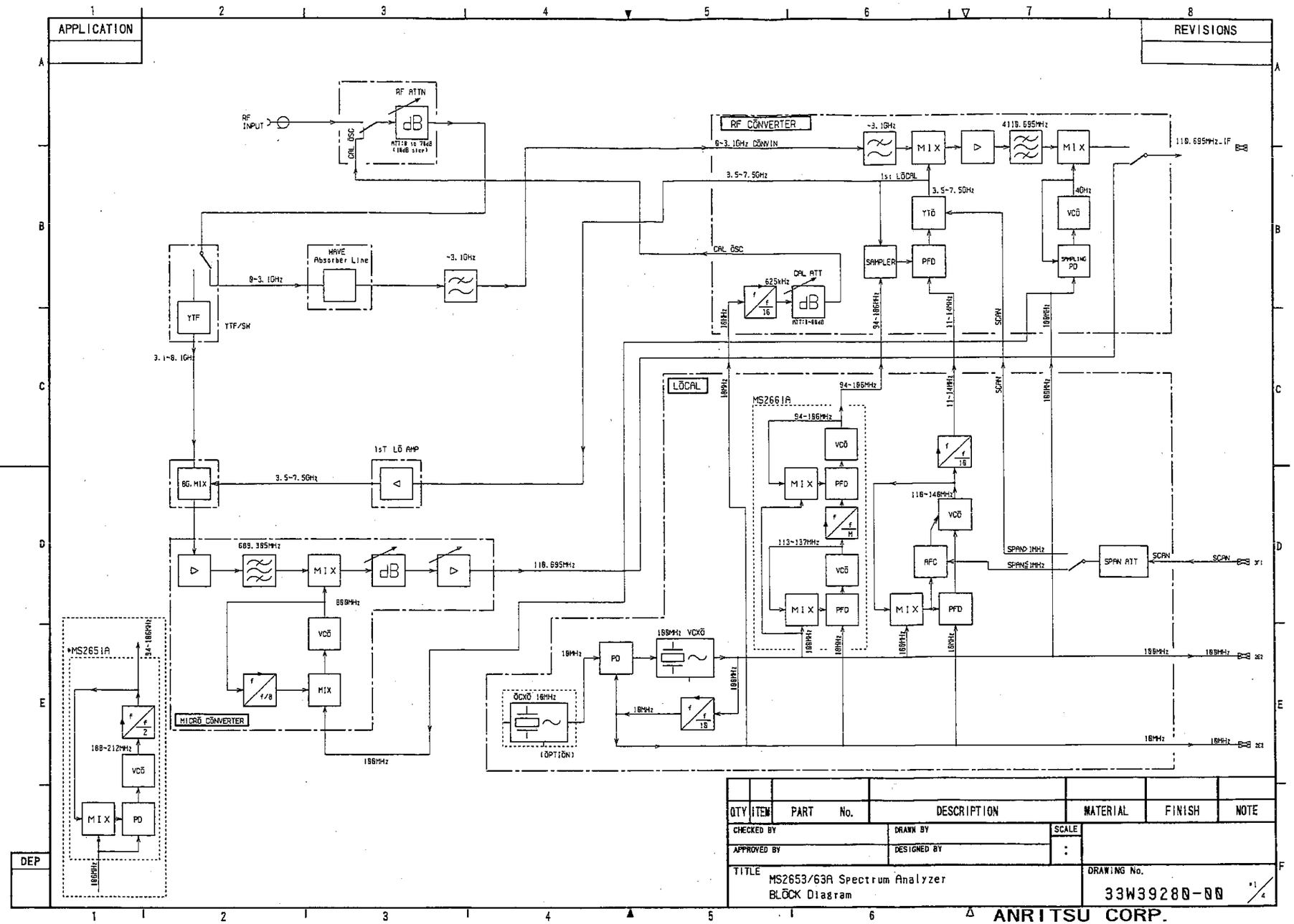
DRAWING No. 33W35947-01 *1

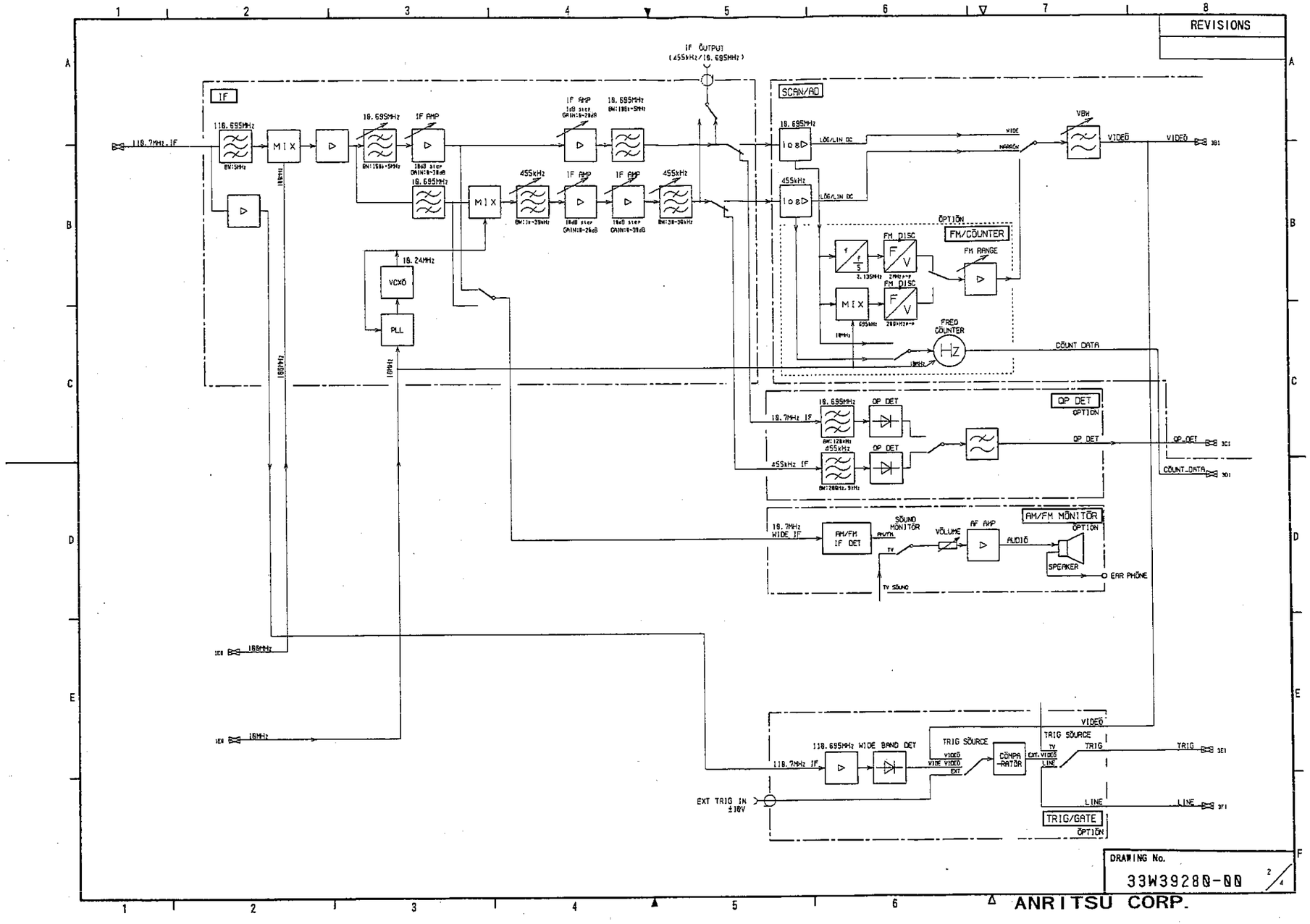
ANRITSU CORP.

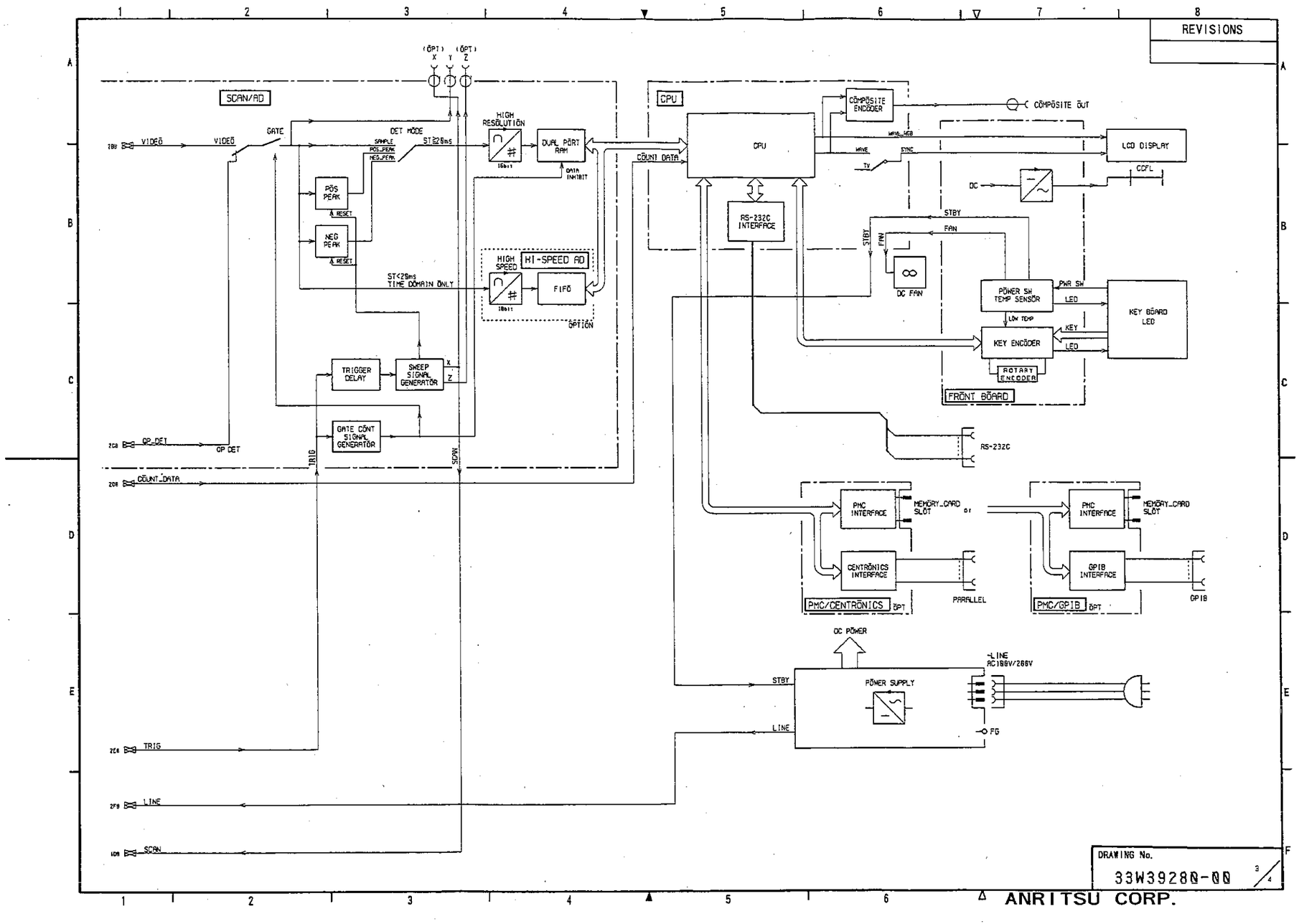

REVISIONS
IF
SCAN/AD
IF OUTPUT
(455kHz/16.695MHz)
118.7MHz IF
16.695MHz
455kHz
MIX
16.24MHz
VCXO
PLL
IF AMP
LOG/LIN DC
WIDE
NARROW
VBW
VIDEO
FM/COUNTER
OPTION
FM DISC
FM RANGE
FREQ COUNTER
COUNT DATA
OP DET
118.695MHz WIDE BAND DET
AM/FM MONITOR
SOUND MONITOR
AM/FM IF DET
VOLUME
AF AMP
AUDIO
SPEAKER
EAR PHONE
TV SOUND
VIF/SIF
VIDEO CROMA
TV RGB
TV SYNC
OSC
SYNC SEPARATOR
LINE COUNTER
TV MONITOR
TRIG SOURCE
COMPA-RATOR
TRIG
LINE
TRIG/GATE
EXT TRIG IN ±16V
DRAWING No.
33W35947-01
2/4
ANRITSU CORP.

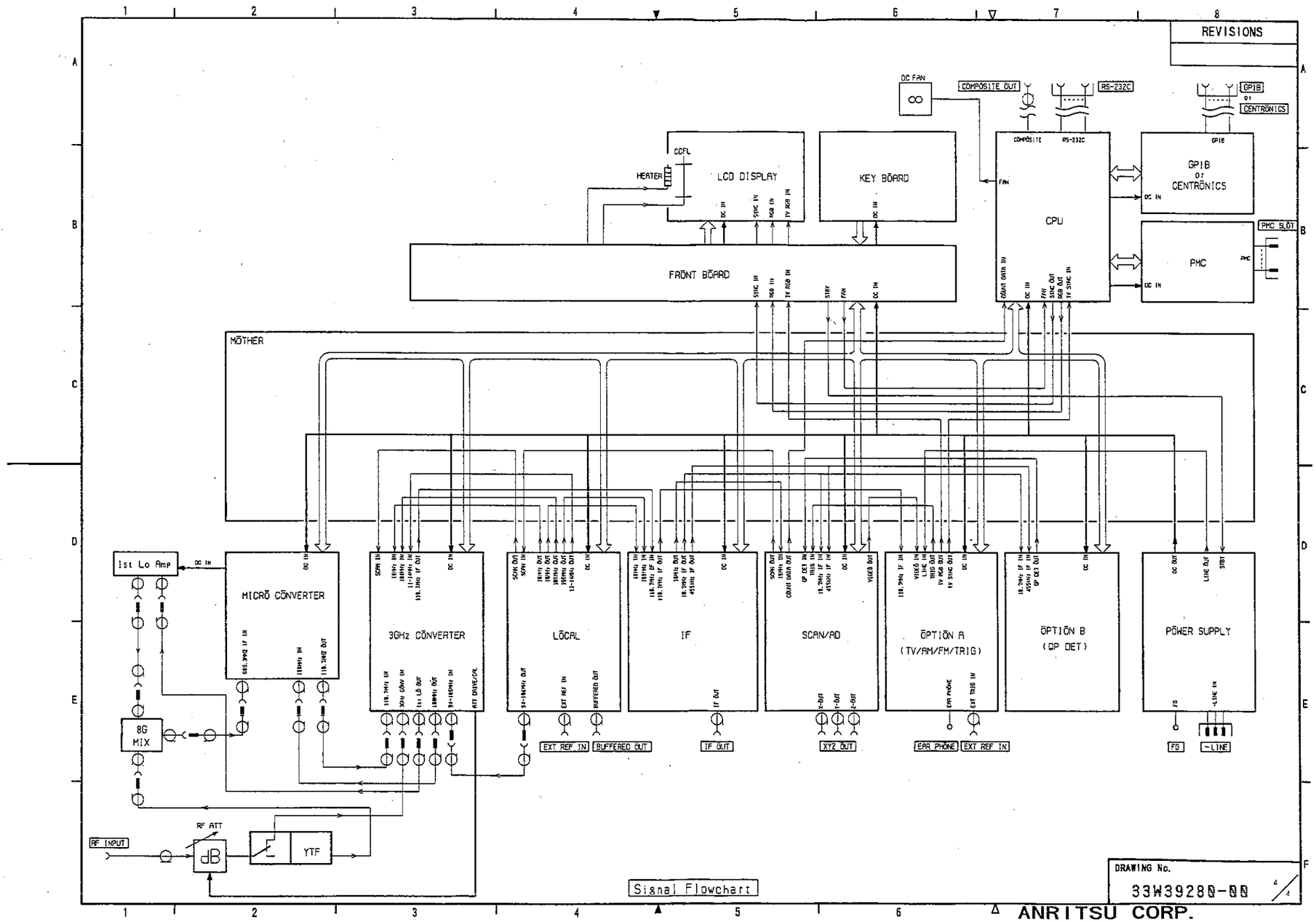

REVISIONS
SCAN/AD
CPU
VIDEO
GATE
DET MODE
SAMPLE
POS_PEAK
NEG_PEAK
ST≧20ms
HIGH RESOLUTION
16bit
DUAL PORT RAM
DATA INHIBIT
POS PEAK
NEG PEAK
RESET
HIGH SPEED
HI-SPEED AD
ST<20ms TIME DOMAIN ONLY
10bit
FIFO
OPTION
TRIGGER DELAY
SWEEP SIGNAL GENERATOR
GATE COUNT SIGNAL GENERATOR
TRIG
SCAN
OP_DET
COUNT_DATA
TV_RGB
TV_SYNC
LINE
SCAN
COMPOSITE ENCODER
COMPOSITE OUT
CPU
RS-232C INTERFACE
WAVE_RGB
TV_RGB
WAVE
SYNC
TV
LCD DISPLAY
DC
CCFL
STBY
FAN
DC FAN
POWER SW TEMP SENSOR
PWR SW
LED
LOW TEMP
KEY
KEY BOARD LED
KEY ENCODER
ROTARY ENCODER
FRONT BOARD
RS-232C
PMC INTERFACE
MEMORY_CARD SLOT
or
CENTRONICS INTERFACE
PARALLEL
PMC/CENTRONICS OPT
GPIB INTERFACE
GPIB
PMC/GPIB OPT
DC POWER
POWER SUPPLY
LINE
AC(88V/264V
FG
DRAWING No.
33W35947-01
3/4
ANRITSU CORP.


REVISIONS
DC FAN
COMPOSITE OUT
RS-232C
GPIB or CENTRONICS
CCFL
HEATER
LCD DISPLAY
KEY BOARD
CPU
GPIB or CENTRONICS
PMC SLOT
PMC
FRONT BOARD
MOTHER
TRACKING GENERATOR
3GHz CONVERTER
LOCAL
IF
SCAN/AD
OPTION A (TV/AM/FM/TRIG)
OPTION B (QP DET)
POWER SUPPLY
TG OUTPUT
RF INPUT
RF ATT
AMP
EXT REF IN
BUFFERED OUT
IF OUT
XYZ OUT
EAR PHONE
EXT REF IN
FG
-LINE
Signal Flowchart
DRAWING No.
33W35947-01
ANRITSU CORP.


APPLICATION
REVISIONS
RF INPUT
RF ATTN
CAL ÖSC
ATT:0 to 70dB (10dB step)
WAVE Absorber Line
0~3.1GHz
~3.1GHz
YTF
YTF/SW
3.1~8.1GHz
RF CÖNVERTER
0~3.1GHz CÖNVTN
~3.1GHz
MIX
4118.695MHz
118.695MHz IF
3.5~7.5GHz
1st LÖCAL
YTÖ
VCÖ
40Hz
CAL ÖSC
SAMPLER
PFD
SAMPLING PD
625kHz
CAL ATT
ATT:1~80dB
16MHz
94~186MHz
11~14MHz
SCAN
100MHz
LÖCAL
MS2661A
94~186MHz
VCÖ
MIX
PFD
116~146MHz
113~137MHz
SPAN 1MHz
SPAN 3MHz
AFC
SPAN ATT
SCAN
1st LÖ AMP
8G. MIX
3.5~7.5GHz
689.385MHz
118.695MHz
88MHz
MIXER CÖNVERTER
186MHz
*MS2651A
94~186MHz
188~212MHz
160MHz
168MHz VCXÖ
ÖCXÖ 16MHz
(ÖPTIÖN)
168MHz
16MHz
DEP
QTY
ITEM
PART No.
DESCRIPTION
MATERIAL
FINISH
NOTE
CHECKED BY
DRAWN BY
SCALE
APPROVED BY
DESIGNED BY
TITLE
MS2653/63A Spectrum Analyzer
BLÖCK Diagram
DRAWING No.
33W39280-00
ANRITSU CORP.


REVISIONS
IF OUTPUT (455kHz/18.695MHz)
IF
118.7MHz IF
118.695MHz
BW:5MHz
MIX
18.695MHz
IF AMP
18dB step
GAIN:0~30dB
BW:150k~5MHz
IF AMP
1dB step
GAIN:0~20dB
18.695MHz
BW:150k~5MHz
455kHz
IF AMP
IF AMP
455kHz
BW:3k~30kHz
18dB step
GAIN:0~26dB
18dB step
GAIN:0~31dB
BW:3k~30kHz
MIX
18.24MHz
VCXO
PLL
18MHz
18MHz
18MHz
SCAN/AD
18.695MHz
LOG/LIN DC
VIDEO
NARROW
VBW
VIDEO
VIDEO
J81
455kHz
LOG/LIN DC
OPTION
FM/COUNTER
FM DISC
FM RANGE
FM DISC
MIX
695kHz
10MHz
FREQ COUNTER
COUNT DATA
10MHz
QP DET
OPTION
18.695MHz
QP DET
18.7MHz IF
BW:120kHz
455kHz
QP DET
QP DET
455kHz IF
BW:280Hz~9kHz
QP DET
J81
COUNT DATA
J81
AM/FM MONITOR
OPTION
18.7MHz WIDE IF
AM/FM IF DET
SOUND MONITOR
AM/FM
TV
VOLUME
AF AMP
AUDIO
SPEAKER
EAR PHONE
TV SOUND
J81
18MHz
J81
18MHz
VIDEO
TRIG SOURCE
118.695MHz WIDE BAND DET
TRIG SOURCE
VIDEO
WIDE VIDEO
EXT
COMPA-RATOR
TV
EXT. VIDEO
LINE
TRIG
TRIG
J81
118.7MHz IF
EXT TRIG IN ±10V
LINE
LINE
J81
TRIG/GATE
OPTION
DRAWING No.
33W39280-00
2/4
ANRITSU CORP.


REVISIONS
SCAN/AD
CPU
(OPT) X
(OPT) Y
(OPT) Z
VIDEO
GATE
DET MODE
SAMPLE
POS_PEAK
NEG_PEAK
ST≥20ms
HIGH RESOLUTION
16bit
DUAL PORT RAM
DATA INHIBIT
POS PEAK
NEG PEAK
RESET
ST<20ms TIME DOMAIN ONLY
HIGH SPEED
HI-SPEED AD
18bit
FIFO
OPTION
TRIGGER DELAY
SWEEP SIGNAL GENERATOR
GATE CONT SIGNAL GENERATOR
OP_DET
TRIG
SCAN
COUNT_DATA
CPU
COMPOSITE ENCODER
COMPOSITE OUT
WAVE_RGB
WAVE
SYNC
TV
LCD DISPLAY
CCFL
DC
RS-232C INTERFACE
STBY
FAN
DC FAN
POWER SW TEMP SENSOR
PWR SW
LED
LOW TEMP
KEY
KEY ENCODER
KEY BOARD LED
ROTARY ENCODER
FRONT BOARD
RS-232C
PMC INTERFACE
MEMORY_CARD SLOT
CENTRONICS INTERFACE
PMC/CENTRONICS
OPT
PARALLEL
GPIB INTERFACE
PMC/GPIB
GPIB
DC POWER
POWER SUPPLY
LINE
AC198V/264V
FG
TRIG
LINE
SCAN
DRAWING No.
33W3928Q-00
3/4
ANRITSU CORP.


REVISIONS
DC FAN
COMPOSITE OUT
RS-232C
GPIB
or
CENTRONICS
CCFL
HEATER
LCD DISPLAY
KEY BOARD
CPU
GPIB
or
CENTRONICS
PMC SLOT
PMC
FRONT BOARD
MOTHER
1st Lo Amp
MICRO CONVERTER
3GHz CONVERTER
LOCAL
IF
SCAN/AD
OPTION A
(TV/AM/FM/TRIG)
OPTION B
(OP DET)
POWER SUPPLY
8G
MIX
RF INPUT
RF ATT
dB
YTF
EXT REF IN
BUFFERED OUT
IF OUT
XYZ OUT
EAR PHONE
EXT REF IN
FG
-LINE
Signal Flowchart
DRAWING No.
33W39280-00
4/4
ANRITSU CORP.

Head office address was changed

Head office address on the back cover was changed. Please substitute it as the following address.

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22 September 2003

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