MS2650/MS2660B/C Series
Spectrum Analyzer
Operation Manual
Vol. 1
(Basic Operating Instructions)

16th Edition

For safety and warning information, please read this manual before attempting to use the equipment.
Keep this manual with the equipment.

ANRITSU CORPORATION

Document No.: M-W1251AE-16.0

Safety Symbols

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

Symbols used in manual

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

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

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

Safety Symbols Used on Equipment and in Manual

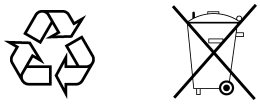
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.

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

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

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

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



These indicate that the marked part should be recycled.

MS2650/MS2660B/C Series
Spectrum Analyzer
Operation Manual Vol. 1 (Basic Operating Instructions)

14 March 1997 (First Edition)
10 December 2007 (16th 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 advice in the operation manual is not followed there is a risk of personal injury or reduced equipment performance. The alert mark shown on the left may also be used with other marks and descriptions to indicate other dangers.

2. IEC 61010 Standard
   The IEC 61010 standard specifies four categories to ensure that an instrument is used only at locations where it is safe to make measurements. This instrument is designed for measurement category I (CAT I). DO NOT use this instrument at locations specified as category II, III, or IV as defined below.
   Measurement category I (CAT I):
   Secondary circuits of a device that is not directly connected to a power outlet.
   Measurement category II (CAT II):
   Primary circuits of a device that is directly connected to a power outlet, e.g., portable tools or home appliance.
   Measurement category III (CAT III):
   Primary circuits of a device (fixed equipment) to which power is supplied directly from the distribution panel, and circuits running from the distribution panel to power outlet.
   Measurement category IV (CAT IV):
   Building service-line entrance circuits, and circuits running from the service-line entrance to the meter or primary circuit breaker (distribution panel).

Electric Shock

3. To ensure that the instrument is earthed, always use the supplied 3-pin power cord, and insert the plug into an outlet with an earth terminal. If power is supplied without earthing the equipment, there is a risk of receiving a severe or fatal electric shock or causing damage to the internal components.

For Safety

WARNING ⚠

Repair

WARNING ⚠

4. This equipment cannot be repaired by the operator. DO NOT attempt to remove the equipment covers or unit covers or to disassemble internal components. Only qualified service personnel 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 components.

Falling Over

5. This equipment should always be positioned in the correct manner. 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.
   Always set up the equipment in a position where the power switch can be reached without difficulty.

Calibration

6. The performance-guarantee seal verifies the integrity of the equipment. To ensure the continued integrity of the equipment, only Anritsu service personnel, or service personnel of an Anritsu sales representative, should break this seal to repair or calibrate the equipment. If the performance-guarantee seal is broken by you or a third party, the performance of the equipment cannot be guaranteed. Be careful not to break the seal by opening the equipment or unit covers.

Battery Fluid

7. DO NOT short the battery terminals and never attempt to disassemble the battery 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 the battery fluid, 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, rinse them with clean running water and seek medical help. If the liquid gets on your skin or clothes, wash it off carefully and thoroughly.

LCD

8. 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, rinse 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 ⚠

Fuse Replacement

CAUTION ⚠

1. Always remove the mains power cable from the power outlet before replacing blown fuses. There is a risk of electric shock if fuses are replaced with the power cable connected. Always use new fuses of the type and rating specified on the rear panel of the instrument. There is a risk of fire if a fuse of a different rating is used.

   T5A indicates a time-lag fuse.

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. ♦ MS2651B/2661B/2661C (standard:50Ω)
   • Maximum DC voltage ratings:
   RF Input ±DC 50 V
   TG Output ±DC 0 V
   • Maximum AC power (continuous wave) ratings:
   RF Input +30 dBm (RF ATT ≥10 dB)
   TG Output +20 dBm
   NEVER input a over maximum ratings to RF Input and TG Output, excessive power may damage the internal circuits.

   ♦ MS2651B/2661B/2661C (plus opt. 08 preamplifier ON)
   • Maximum DC voltage ratings:
   RF Input ±DC 50 V
   • Maximum AC power (continuous wave) ratings:
   RF Input +10 dBm (RF ATT ≥10 dB)
   NEVER input a over maximum ratings to RF Input, excessive power may damage the internal circuits.

For Safety

♦ MS2651B/2661B/2661C (plus opt. 19 DC Input)

• Maximum DC voltage ratings:

RF Input ±DC 0 V

• Maximum AC power (continuous wave) ratings:

RF Input +30 dBm (RF ATT ≥10 dB)

NEVER input a over maximum ratings to RF Input, excessive power may damage the internal circuits.

♦ MS2651B/2661B/2661C (plus opt. 22, 23:75Ω Input, 75Ω TG)

• Maximum DC voltage ratings:

RF Input ±DC 100 V

TG Output ±DC 0 V

• Maximum AC power (continuous wave) ratings:

RF Input +25 dBm (RF ATT ≥10 dB)

TG Output +20 dBm

NEVER input a over maximum ratings to RF Input and TG Output, excessive power may damage the internal circuits.

♦ MS2653B/2663B/2663C

• Maximum DC voltage ratings:

RF Input ±DC 0 V

• Maximum AC power (continuous wave) ratings:

RF Input +30 dBm (RF ATT ≥10 dB)

NEVER input a over maximum ratings to RF Input, excessive power may damage the internal circuits.

♦ MS2653B/2663B/2663C (plus opt. 08 preamplifier ON)

• Maximum DC voltage ratings:

RF Input ±DC 50 V

• Maximum AC power (continuous wave) ratings:

RF Input +10 dBm (RF ATT ≥10 dB)

NEVER input a over maximum ratings to RF Input, excessive power may damage the internal circuits.

♦ RF Input/TG Output connector

• MS2651B/2661B/2661C/2653B/2663B/2663C (standard:50Ω)

RF Input N-J

TG Output N-J

• MS2651B/2661B/2661C (plus opt. 22, 23:75Ω)

RF Input NC-J

TG Output NC-J

NEVER connect a difference type connector, Connecting a difference type may damage the connector.

For Safety

CAUTION ⚠

Replacing Memory Back-up Battery

This equipment uses a Poly-carbomonofluoride lithium battery to backup the memory. This battery must be replaced by service personnel when it has reached the end of its useful life; contact the Anritsu sales section or your nearest representative.

Note: The battery used in this equipment has a maximum useful life of 7 years. It should be replaced before this period has elapsed.

External Storage Media

This equipment uses memory cards as external storage media for storing data and programs.

If this media is mishandled or becomes faulty, important data may be lost. To prevent this chance occurrence, all important data and programs should be backed-up.

Anritsu will not be held responsible for lost data.

Pay careful attention to the following points.

- Never remove the memory card from the instrument while it is being accessed.
- The memory card may be damaged by static electric charges.
- The back-up battery in SRAM memory cards has a finite life. Replace the battery periodically. For details, refer to the explanation on the memory card later in this manual.
- Anritsu has thoroughly tested all external storage media shipped with this instrument. Users should note that external storage media not shipped with this instrument may not have been tested by Anritsu, thus Anritsu cannot guarantee the performance or suitability of such media.

Disposing of The Product

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.

Use in a residential environment

This instrument is designed for an industrial environment.
In a residential environment this instrument may cause radio interference in which case the user may be required to take adequate measures.

Equipment Certificate

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

Anritsu Warranty

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

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

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

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

Anritsu Corporation Contact

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

Notes On Export Management

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

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

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

Crossed-out Wheeled Bin Symbol

Equipment marked with the Crossed-out Wheeled Bin Symbol complies with council directive 2002/96/EC (the "WEEE Directive") in European Union.

For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

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 Conformity Marking

Anritsu affixes the CE conformity marking on the following product(s) in accordance with the Council Directive 93/68/EEC to indicate that they conform to the EMC and LVD directive of the European Union (EU).

CE marking

CE

1. Product Model

Model: MS2651B/MS2661C/MS2663C Spectrum Analyzer

2. Applied Directive

EMC: Directive 2004/108/EC
LVD: Directive 2006/95/EC

3. Applied Standards

- EMC: Emission: EN 61326-1: 2006 (Class A)
  Immunity: EN 61326-1: 2006 (Table 2)

	Performance Criteria*
IEC 61000-4-2 (ESD)	B
IEC 61000-4-3 (EMF)	A
IEC 61000-4-4 (Burst)	B
IEC 61000-4-5 (Surge)	B
IEC 61000-4-6 (CRF)	A
IEC 61000-4-8 (RPFMF)	A
IEC 61000-4-11 (V dip/short)	B, C

*: Performance Criteria

A: During testing, normal performance within the specification limits.

B: During testing, temporary degradation, or loss of function or performance which is self-recovering.

C: During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.

Harmonic current emissions:
EN 61000-3-2: 2006 (Class A equipment)

- LVD: EN 61010-1: 2001 (Pollution Degree 2)

4. Authorized representative

Name:	Loic Metais European Quality Manager ANRITSU S.A. France
Address, city:	16/18 Avenue du Québec SILIC 720 Zone de Courtaboeuf 91951 Les Ulis Cedex
Country:	France

C-tick Conformity Marking

Anritsu affixes the C-tick mark on the following product(s) in accordance with the regulation to indicate that they conform to the EMC framework of Australia/New Zealand.

C-tick marking

1. Product Model

Model: MS2651B/MS2661C/MS2663C Spectrum Analyzer

2. Applied Standards

EMC:Emission: EN 61326-1: 2006 (Class A equipment)

Power Line Fuse Protection

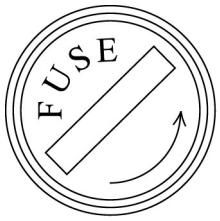
For safety, Anritsu products have either one or two fuses in the AC power lines as requested by the customer when ordering.

Single fuse: A fuse is inserted in one of the AC power lines.

Double fuse: A fuse is inserted in each of the AC power lines.

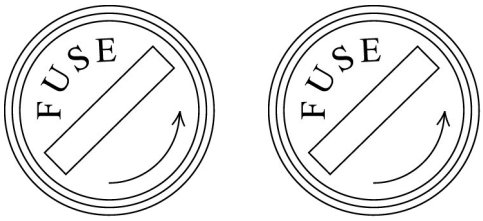
Example 1: An example of the single fuse is shown below:

Fuse Holder



Example 2: An example of the double fuse is shown below:

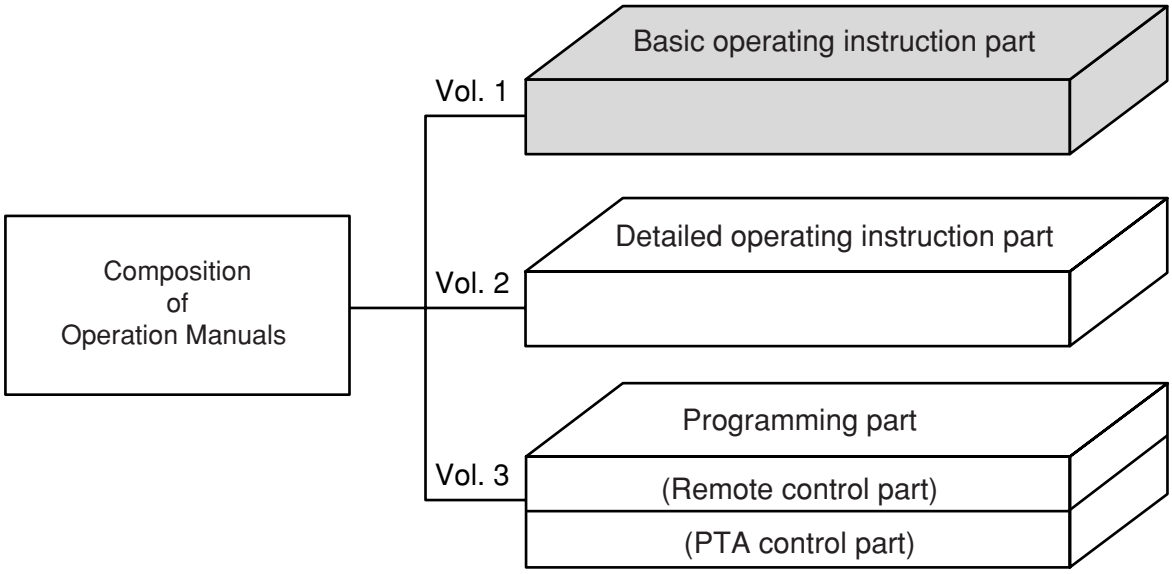
Fuse Holders



ABOUT THIS MANUAL

(1) Composition of MS2650/MS2660B/C Series Operation Manuals

The MS2650/MS2660B/C 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/MS2660B/C Series outline, preparation before use, panel description, basic operation, soft-key menu and performance tests.

Detailed operating instruction part: Detailed Operating Instructions: Provides information on the detailed panel operating instructions on MS2650/MS2660B/C 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.

TABLE OF CONTENTS

SECTION 1
GENERAL

This section outlines the MS2650/MS2660B/C Series Spectrum Analyzer and explains the composition of this manual, the configuration of the MS2650/MS2660B/C Series with the standard accessories, the options, the optional accessories, and peripherals for expanding the MS2650/MS2660B/C Series capabilities, and the MS2650/MS2660B/C Series specifications.

TABLE OF CONTENTS

SECTION 1
GENERAL

Product Outline

The MS2650/MS2660B/C 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 coupled input is mounted: 500 Hz to 3 GHz, when Option 22: 75Ω input is mounted: 100 kHz to 2.5 GHz) (MS2651B/2661B/2661C), 9 kHz to 8.1 GHz (MS2653B/2663B/2663C).
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/cord-less 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 MS2660B/C series is suited for production and building, and the MS2650B series for maintenance.

Composition of Operation Manual

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

Section composition	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
APPENDIX C	PERFORMANCE TEST RECORD

Equipment Configuration

This paragraph describes the configuration of the MS2650/MS2660B/C 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/MS2660B/C series spectrum analyzer with the standard accessories.

Standard Composition

Item	Model/Order NO.	Name	Qty.	Remarks
Main instrument	MS2651B/MS2661B MS2653B/MS2663B MS2661C/MS2663C	Spectrum Analyzer	1	
Accessories		Power cord	1	
	F0013	Fuse	2	T5 A 250 V
	W1251AE	Operation manual	1	

Options

The table below shows the options for the MS2650/MS2660B/C series which are sold separately.

Model † - Order No. †	Name	Remarks
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-01	Reference crystal oscillator	stability: $\leq 2 \times 10^{-8}$/day
MS2661B/MS2663B/ MS2661C/MS2663C-02	Narrow resolution bandwidth	30 Hz, 100 Hz, 300 Hz
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-04	High-speed time domain sweep	1.25 μ s/div
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-06	Trigger/Gate circuit	Pre-trigger and post trigger avilable (Option 16 required for TV trigger)
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-07	AM/FM demodulator (Sound monitor)	Output to loudspeaker or earphone connector
MS2651B/MS2661B/ MS2661C/MS2663C-08	Preamplifier	100 kHz to 3 GHz, Gain=20 dB
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-10	Centronics interface	Not possible when GPIB installed
MS2661B/MS2663B/ MS2661C-12	QP Detector	QP BW=200 Hz, 9 kHz, 120 kHz
MS2651B/MS2653B-13	QP Detector	QP BW=9 kHz, 120 kHz
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-14	PTA Parallel I/O	Controlling external equipment from PTA. Not possible when Option 10 installed
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-15	Sweep signal output	X, Z
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-16	Television monitor	M-NTSC, B/G/H PAL. Option 07 required for audio
MS2661B/MS2661C-19	DC coupled input	Expanding Received frequency to 500 Hz when DC coupled input circuit
MS2651B/MS2661B/ MS26621C-20	Tracking generator	9 kHz to 3 GHz, 0 to -60 dBm
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-21	Television monitor (multi-system)	M-NTSC, B/G/H/I/D PAL. Option 07 required for audio
MS2651B/MS2661B/ MS2661C-22	75 Ω Input	75 Ω, 100 kHz to 2.5 GHz
MS2651B/MS2661B/ MS2661C-23	75 Ω Tracking generator	75 Ω, 100 kHz to 2.5 GHz
MS2651B/MS2661B/ MS2653B/MS2663B/ MS2661C/MS2663C-24	Television monitor (Brazil)	M-NTSC, M PAL. Option 07 required for audio

† 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/MS2660B series which are all sold separately.

Optional Accessories (1/2)

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
CSCJ-256K-SM	256 kB memory card	Meets PCMCIA Ver. 2.0 Type I
CSCJ-512K-SM	512 kB memory card	Meets PCMCIA Ver. 2.0 Type I
CSCJ-001M-SM	1024 kB memory card	Meets PCMCIA Ver. 2.0 Type I
CSCJ-002M-SM	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	Carrying case (hard type)	With casters
B0391B	Carrying 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)
J0805	DC Block Adaptor	50 Ω (10 kHz to 18 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)
J0078	Fixed Foxed Power for high power	20 dB (10 W, DC to 18 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

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

Optional Accessories (2/2)

Model - Order No.	Name	Remarks
J0055	Coaxial Adaptor	75 Ω, NC-P · BNC-J
J0076	Coaxial Adaptor	75 Ω, NC-P · F-J
MH648A	Pre-amplifier	0.1 to 1200 MHz, 30 dB
HP534A	Dipole Antenna	25 to 520 MHz
MP651A	Dipole Antenna	470 to 1700 MHz
BBA9106/VHA9103	Biconical Antenna	30 to 300 MHz (Schwarzbeck product)
6502	Loop Antenna	10 kHz to 30 MHz (Emco product)
MP414B	Loop Antenna	9 kHz to 30 MHz, 3 bands
MP415B	Rod Antenna	9 kHz to 30 MHz, 3 bands
MP635A	Log Periodic Antenna	80 to 1000 MHz, 30 dB
MP666A	Log Periodic Antenna	200 to 2000 MHz, 30 dB
MB18B	Pole	For MP666A
MB9A	Tripod	For MP666A
MB19A	Tripod	For MP635A/MP666A (with Pole)
MN423B	Artficial Main Network	CISPR Pub. 16,150 kHz to 30 MHz
MN424B	Artficial Main Network	FCC Part 15,450 kHz to 30 MHz
MN425B	Artficial Main Network	VDE 0876,10 kHz to 30 MHz
MA2601B	EMI Prove	5 to 1000 MHz
MA2601C	EMI Prove	1 to 50 MHz
KT-10	EMI Clamp	
KT-20	EMI Prove Kit	
60N50-1	SWR Bridge	5 MHz to 2 GHz, 50 Ω, N-P
60NF50-1	SWR Bridge	5 MHz to 2 GHz, 50 Ω, N-J
62N75	SWR Bridge	10 MHz to 1 GHz, 75 Ω, NC-P
62NF75	SWR Bridge	10 MHz to 1 GHz, 75 Ω, NC-J
87A50	SWR Bridge	2 to 18 GHz, 50 Ω, GPC-7
J0007	GP-IB Cable	408JE-101
J0008	GP-IB Cable	408JE-102
J0742A	RS232C Cable	D-sub 25 pins (straight)
J0743A	RS232C Cable	For IBM PC/AT compatible, D-sub 9pins (cross)

Specifications

Except were noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference, and are not guaranteed.

Model			MS2651B	MS2661B
Frequency	Frequency range		9 kHz to 3 GHz	
	Frequency readout accuracy		±(frequency readout × reference frequency accuracy + span × span accuracy +100 Hz) *Span:≥10 kHz, after calibration	
	Marker frequency readout accuracy		Normal: Same as frequency readout accuracy, Delta: Same as frequency span accuracy	
	Frequency counter		Resolutions: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Frequency readout × reference frequency accuracy ±1 LSD (when S/N is ≥20 dB)	
	Frequency span		Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5 % (span ≥10 kHz)	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5 % (span ≥10kHz), ±5 % (span ≤10 kHz, Option02 installed)
	Resolution band width (RBW) (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) *Option02 (MS2661B only):30 Hz, 100 Hz, 300 Hz are added. Measurements of such as noise, C/N, adjacent channel leakage power by measure function are executed with the caluculated equivalent noise band width of the resolution band width. Selectivity (60 dB:3 dB): ≤10:1 (RBW= 1 kHz to 300 kHz), ≤15:1 (RBW=1 MHz, 5 MHz)	
	Video band width (VBW)		1 Hz to 3 MHz (1–3 sequence), off* 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 sec (1 GHz,span=0 Hz) Frequency drift: ≤200 Hz/min (span ≤10 kHz, sweep time ≤100 sec)*After 1–hour warm-up at constant ambient temperature	
	Reference oscillator		Frequency: 10 MHz Aging rate: 2×10^{-6}/year (typical); Option01:1×10^{-7}/year, 2×10^{-8}/day Temperature characterristics:1×10^{-5}(typical, 0°C to 50°C); Option01: $\pm 5 \times 10^{-8}$ (0°C 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 to 3 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 to 3 GHz) *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 3 GHz)	≤–100 dBm (input attenuator: 0 dB,input: 50 Ω termination, 1 MHz to 3 GHz)
	Total level accuracy		±1.3 dB (100 kHz to 3 GHz) Level measurement accuracy after calibration using internal calibration signal Total level accuracy: reference level accuracy (0 to –49.9 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 dBm 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 band width, video bandwidth, and sweep time set to AUTO) Resolution bamdwidth 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 (RF ATT) 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 dB (0 to 70 dB) *After calibration, referenced to frequecy 100MHz, input attenuator 10 dB	
	Frequency response		±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 10dB, temperature 18° to 28°C) ±1.5 dB (9 to 100 kHz, referenced to 100 MHz, input attenuator 10dB, temperature 18° to 28°C) ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 10 dB to 50 dB)	

(Continued)

	Model	MS2651B	MS2661B
Amplitud	Scale Fidelity	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), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4 % of 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, mixer level: –30 dBm) ≤–60 dBc (0.1 to 1.5 GHz, mixer level: –30 dBm) 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer level: –30 dBm) ≤–75 dBc (0.2 to 1.5 GHz, mixer level: –30 dBm) ≤–80 dBc (0.8 to 1 GHz, mixer level: –30 dBm) 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 100 MHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm) ≤–80 dBc (0.1 to 3 GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)	
	Maximam dynamic range	1 dB gain compression level vs. average noise level: >105 dB(100 MHz to 1 GHz) >105 –f[GHz]dB (>1 GHz) Distortion characterristics (1 kHz RBW) 2nd harmonic: >67.5 dB (10 to 100 MHz) >70 dB (100 to 500 MHz) >70 –f[GHz]dB (500 to 1500 MHz) 3rd order intermodulation: >76.6 dB (10 to 1000 MHz) >76.6 –(2/3)f[GHz]dB (1 to 3 GHz)	1 dB gain compression level vs. average noise level: >110 dB(100 MHz to 1 GHz) >110 –f[GHz]dB (>1 GHz) when Option08 pre-amplifier installed: >109 dB (100 MHz to 1 GHz) >109 –1.5f[GHz]dB (>1 GHz) Distortion characterristics (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 order intermodulation: >80 dB (10 to 100 MHz) >83.3 dB (100 to 1000 MHz) >83.3 –(2/3) f[GHz]dB (1 to 3 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 s to 1000 s), ±1 % (digital zero span mode)	
	Sweep mode	Continious, single	
	Sweep mode in time domain	Analog zero span, digital zero span	
	Zone sweep	Sweeps only in frequency range indicated by zone marker	
	Tracking sweep	Sweeps while tracking peak points within zone marker (zone sweep also possible)	
Functions	Numbers of 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 uncertaity: ±0.5 dB (at reference level)	
	Display	Color TFT-LCD, Size 5.5", Number of colors: 17 (RGB,each 64-scale settable), Brightness:5-steps settable	
	Display function	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: Display 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+DL→A	
	Storage functions	NORMAL, VIEW, MAX HOLD, AVERAGE, CUMULATIVE, OVERWRITE	

(Continued)

Model		MS2651B	MS2661B
Functions	FM demodulation waveform display	Setting range: 2, 5, 10, 20, 50, 100, 200 kHz/div Accuracy: –5 % of full scale (referenced to center frequency after calibration, DC-coupled, RBW 5 MHz, VBW 1 Hz, CW) Frequency response (3 dB): DC (50 Hz at AC coupled) to 100 kHz (range †20 kHz/div, VBW off), DC (50 Hz at AC coupled) to 500 kHz (range ‡50 kHz/div, VBW off) *Usable RBW: ‡100 kHz	
	Input connector	N-J, 50 Ω	
	Auxiliary signal input and output	IF OUTPUT: 455 kHz (RBW: †30 kHz), 10.695 MHz (RBW: ‡100kHz), 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	Numbers 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, dBm/Hz), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, REF: reference level method, REF: inband method, channel designate display: 2 channels × 2,graphic diplay), average power of burst signal (average power in designate time range of time domain waveform), template comparison (upper/lower limits × each 2, time domain), MASK (upper/lower limits × each 2, frequency domain)	
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max.12) or memory card	
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible model): Display data can be hard-copied via the RS232C, GPIB, or Centoronics (Option10) interface Plotter (HP-GL, GP-GL compatible models): Display data can be hard-copied via the RS232C or GPIB interface	
	PTA	Language: PTL (interpreter based on BASIC) Progamming: Using editor of external computer Progamming memory: Memory card, upload/download to/from external computer Progamming capacity: 192 kbytes Data processing: Directly accesses measurement data according to sysytem variables, system subroutines, and system functions	
	RS-232C	Output data to printer or plotter. Control from external computer (excluding power switch)	
	GPIB interface	Functions: Meets IEEE488.2, Can be controlled as device from external controller (excluding power switch), or can control external equipment as controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28	
	Memory card interface	Functions: Save/recall measurement settings and data, uploads/downloads PTA programs, access SRAM, EPROM and flash EEPROM (can write to SRAM only), Supports cards up to 2 MB Connector: PCMCIA Ver.2.0 2 slots	
	Correction	Autocorrection of MA1621A inpedance transformer 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) Antenna factor Indication of the correction waveform data by antenna factor of a designated antenna and measurement of field strength (dB V/m) Built-in antenna factor Dipole antenna: MP534A/MP651A Log-Periodic Antenna: MP635A/MP666A Loop Antenna: MP414B User: Programmable through GPIB or RS-232C or PTA (4 types) Saving/Loading to/from Memory card possible	
Others	Conducted disturbance	Meets EN 61326-1: 2006 (Class A)	
	Radiated disturbance	Meets EN 61326-1: 2006 (Class A)	
	Harmonic Current Emission	Meets EN 61000-3-2: 2006 (Class A)	
	Electrostatic Discharge	Meets EN 61326-1: 2006 (Table 2)	
	Electromagnetic Field Immunity	Meets EN 61326-1: 2006 (Table 2)	
	Fast Transient / Burst	Meets EN 61326-1: 2006 (Table 2)	
	Surge	Meets EN 61326-1: 2006 (Table 2)	
	Conducted RF	Meets EN 61326-1: 2006 (Table 2)	
	Power Frequency Magnetic Field	Meets EN 61326-1: 2006 (Table 2)	
	Voltage Dips / Short Interruptions	Meets EN 61326-1: 2006 (Table 2)	
	Vibration	Meets the MIL-STD-810D	
	Power (operating range)	85 to 132 / 170 to 250 V (automatic voltage switching), 47.5 to 63 Hz/380 to 420 Hz (85 to 132 V only), † 320 VA	
	Dimensions and mass	320 (W) × 177 (H) × 351 (D), † 10.8 kg(without option)	
	Ambient temperature	0¡ to 50¡C (operate), —40¡ to + 75¡C (storage)	

(Continued)

Model			MS2653B	MS2663B
Frequency	Frequency range		9 kHz to 8.1 GHz	
	Frequency band		Band 0 (0 to 3.2 GHz), band 1– (2.92 GHz to 6.5 GHz), band 1+ (6.4 GHz to 8.1 GHz)	
	Pre-selector range		2.92 GHz to 8.1 GHz (band 1–, band 1+)	
	Frequency readout accuracy		± (frequency readout × reference frequency accuracy + span × span accuracy +100 Hz) *Span: ≥10 kHz, after calibration	
	Marker frequency readout accuracy		Normal: Same as frequency readout accuracy, Delta: Same as frequency span accuracy	
	Frequency counter		Resolutions: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Frequency readout × reference frequency accuracy ±1 LSD (when S/N is 20 dB)	
	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, Option02 installed)
	Resolution bandwidth (RBW) (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) *Option02 (MS2663B only): 30 Hz, 100 Hz, 300 Hz are added. Measurements of such as noise, C/N, adjacent channel leakage power by measure function are executed with the caluculated equivalent noise band width of the resolution band width. Selectivity (60 dB: 3 dB): ≤10:1 (RBW=1 kHz to 300 kHz), ≤15:1 (RBW=1 MHz, 5 MHz)	
	Video bandwidth (VBW)		1Hz to 3 MHz (1-3 sequence), off *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 sec (1 GHz, span=0 Hz) Frequency drift: ≤200 Hz/min (span ≤10 kHz, sweep time ≤100 sec)* After 1-hour warm-up at constant ambient temperature	
	Reference oscillator		Frequency: 10 MHz Aging rate: (typical); Option01: 1×10^{-7}/year, 2×10^{-8}/day Temperature characterristics: 1×10^{-5} (typical, 0°C to 50°C); Option01: $\pm 5 \times 10^{-8}$ (0°C 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 (2.92 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 GHz,band 0) ≤–115 dBm +0.5f[GHz]dB (2.92 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 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 –49.9 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, dBµV(e.m.f), W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 dBm 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 bamdwidth 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 (RF ATT) 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 dB (0 to 70 dB) *After calibration, referenced to frequecy 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 (2.92 to 8.1 GHz, band 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, referenced to 100 MHz, input attenuator 10 dB to 50 dB) ±1.0 dB (2.92 to 8.1 GHz, band 1, referenced to 100 MHz, input attenuator 10 dB to 50 dB) *At band 1, after pre-selector tuning	

(Continued)

	Model	MS2653B	MS2663B
Amplitud	Scale Fidelity	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), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±1.0 dB (0 to –90 dB) Linear scale: ±4 % of 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 level: –30 dBm) ≤–60 dBc (0.1 to 1.55 GHz, band 0, mixer level: –30 dBm) ≤–100 dBc (1.46 to 4.05 GHz, band 1, mixer level: –20 dBm) 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 8.1 GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer level: –30 dBm) ≤–75 dBc (0.2 to 1.3 GHz, band 0, mixer level:–30 dBm) ≤–70 dBc (1.3 to 1.55 GHz, band 0, mixer level:–30 dBm) ≤–80 dBc (0.8 to 1 GHz, mixer level: –30 dBm) ≤–100 dBc (1.46 to 4.05 GHz, band 1, mixer level: –20 dBm) 3rd order inte rmodulation distortion: ≤–70 dBc (10 MHz to 100 MHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm) ≤–80 dBc (0.1 to 8.1 GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)
		Image response: ≤–70 dBc Multiple respose: ≤–70 dBc	
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)	
	Maximam dynamic range	1 dB gain compression level to average noise level: >105 dB (100 MHz to 1 GHz, band 0) >105 –f[GHz]dB (1 to 3.1 GHz, band 0) >105 –0.5f[GHz]dB (2.92 to 8.1 GHz, band 1) Distortion characterristics (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, band0) >95 –0.25f[GHz]dB (1.46 to 4.05 GHz, band1) 3rd order intermodulation: >76.6 dB (10 to 1000 MHz) >76.6 –(2/3)f[GHz]dB (1 to 3.1 GHz, band0) >76.6 –(1/3)f[GHz]dB (2.92 to 8.1 GHz, band1)	1 dB gain compression level vs. average noise level: >110 dB (100 MHz to 1 GHz, band0) >110 –1.5f[GHz]dB (1 to 3.1 GHz, band0) >110 –0.5f[GHz]dB (2.92 to 8.1 GHz, band1) Distortion characterristics (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, band0) >82.5 –0.75f[GHz]dB (0.8 to 1 GHz, band0) >77.5 –0.75f[GHz]dB (1.3 to 1.55 GHz, band0) >97.5 –0.25f[GHz]dB (1.46 to 4.05 GHz, band1) 3rd order intermodulation: >80 dB (10 to 100 MHz) >83.3 dB (0.1 to 1 GHz) >83.3 –f[GHz]dB (1 to 3.1 GHz, band0) >83.3 –(1/3)f[GHz]dB (1.46 to 8.1 GHz, band1)
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 s to 1000 s), ±1 % (digital zero span mode)	
	Sweep mode	Continious, single	
	Sweep mode in time domain	Analog zero span, digital zero span	
	Zone sweep	Sweeps only in frequency range indicated by zone marker	
	Tracking sweep	Sweeps while tracking peak points within zone marker (zone sweep also possible)	
Functions	Numbers of 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 uncertaity: ±0.5 dB (at reference level)	
	Display	Color TFT-LCD, Size 5.5", Number of colors: 17 (RGB, each 64-scale settable), Brightness: 5-steps settable	
	Display function	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: Display 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+DL→A	
	Storage functions	NORMAL, VIEW, MAX HOLD, AVERAGE, CUMULATIVE, OVERWRITE	

(Continued)

Model		MS2653B / MS2663B
Functions	FM demodulation waveform display	Setting range: 2, 5, 10, 20, 50, 100, 200 kHz/div Accuracy: –5 % of full scale (referenced to center frequency after calibration, DC-coupled, RBW 5 MHz, VBW 1 Hz, CW) Frequency response (3 dB): DC (50 Hz at AC coupled) to 100 kHz (range †20 kHz/div, VBW off), DC (50 Hz at AC coupled) to 500 kHz (range ‡50 kHz/div, VBW off) *Usable RBW: ‡100 kHz
	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	Numbers 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, dBm/Hz), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, REF: reference level method, REF: inband method, channel designate display: 2 channels × 2, graphic diplay), average power of burst signal (average power in designate time range of time domain waveform), template comparison (upper/lower limits × each 2, time domain), MASK (upper/lower limits × each 2, frequency domain)
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max.12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible model): Display data can be hard-copied via the RS232C, GPIB, or Centoronics (Option10) interface Plotter (HP-GL, GP-GL compatible models): Display data can be hard-copied via the RS232C or GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Progamming: Using editor of external computer Progamming memory: Memory card, upload/download to/from external computer Progamming capacity: 192 kbytes Data processing: Directly accesses measurement data according to sysytem variables, system subroutines, and system functions
	RS-232C	Output data to printer or plotter. Control from external computer (excluding power switch)
	GPIB interface	Functions: Meets IEEE488.2, Can be controlled as device from external controller (excluding power switch), or can control external equipment as controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Memory card interface	Functions: Save/recall measurement settings and data, uploads/downloads PTA programs, access SRAM, EPROM and flash EEPROM (can write to SRAM only), Supports cards up to 2 MB Connector: PCMCIA Ver.2.0 2 slots
	Correction	Autocorrection of MA1621A inpedance transformer 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) Antenna factor Indication of the correction waveform data by antenna factor of a designated antenna and measurement of field strength (dB V/m) Built-in antenna factor Dipole antenna: MP534A/MP651A Log-Periodic Antenna: MP635A/MP666A Loop Antenna: MP414B User: Programmable through GPIB or RS-232C or PTA (4 types) Saving/Loading to/from Memory card possible
Others	Conducted disturbance	Meets EN 61326-1: 2006 (Class A)
	Radiated disturbance	Meets EN 61326-1: 2006 (Class A)
	Harmonic Current Emission	Meets EN 61000-3-2: 2006 (Class A)
	Electrostatic Discharge	Meets EN 61326-1: 2006 (Table 2)
	Electromagnetic Field Immunity	Meets EN 61326-1: 2006 (Table 2)
	Fast Transient / Burst	Meets EN 61326-1: 2006 (Table 2)
	Surge	Meets EN 61326-1: 2006 (Table 2)
	Conducted RF	Meets EN 61326-1: 2006 (Table 2)
	Power Frequency Magnetic Field	Meets EN 61326-1: 2006 (Table 2)
	Voltage Dips / Short Interruptions	Meets EN 61326-1: 2006 (Table 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132 /170 to 250 V (automatic voltage switching), 47.5 to 63 Hz/380 to 420 Hz (85 to 132 V only), †320 VA
	Dimensions and mass	320 (W) × 177 (H) × 351 (D), †13.5 kg(without option)
	Ambient temperature	0¡ to 50¡C (operate) ,—40¡ to +75¡C (storage)

(Continued)

Model			MS2661C
Frequency	Frequency range		9 kHz to 3 GHz
	Frequency readout accuracy		± (frequency readout × reference frequency accuracy + span × span accuracy +100 Hz) *Span: ≥10 kHz, after calibration
	Marker frequency readout accuracy		Normal: Same as frequency readout accuracy, Delta: Same as frequency span accuracy
	Frequency counter		Resolutions: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Frequency readout × reference frequency accuracy ±1 LSD (when S/N is 20 dB)
	Frequency span		Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5 % (span ≥10 kHz), ±5 % (span ≤10 kHz, Option02 installed)
	Resolution bandwidth (RBW) (3 dB BW)		Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz,3 MHz (manually or automatically settable according to frequency span) *Option02: 30 Hz, 100 Hz, 300 Hz are added. Measurements of such as noise , C/N, adjacent channel leakage power by measure function are executed with the caluculated equivalent noise band width of the resolution band width. Accuracy: ±20 %(RBW=1 kHz to 1 MHz), ±30 % (RBW=3 MHz) Selectivity (60 dB:3 dB): ≤15:1
	Video bandwidth (VBW)		1 Hz to 3 MHz (1-3 sequence), off *manually or automatically settable according to resolution bandwidth
	Signal purity and stability		Noise sidebands: ≤–100 dBc/Hz (1 GHz, 10 kHz offset)
			Residual FM: ≤20 Hzp-p/0.1 sec (1 GHz, span=0 Hz) Frequency drift: ≤200 Hz/min (span ≤10 kHz, sweep time ≤100 sec)*After 1-hour warm-up at constant ambient temperature
	Reference oscillator		Frequency: 10 MHz Aging rate: (typical); Option01: 1×10^{-7}/year, 2×10^{-8}/day Temperature characterristics: 1×10^{-5} (typical, 0°C to 50°C); Option01: $\pm 5 \times 10^{-8}$ (0°C 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	≤–115 dBm (1 MHz to 1 GHz) ≤–115 dBm + f[GHz]dB (1 to 3 GHz) When Option08 pre-amplifier installed: ≤–114 dBm (1 MHz to 1 GHz) ≤–114 dBm + 1.5f[GHz]dB (>1 GHz) *Resolution bandwidth: 1 kHz, video bandwidth: 1 Hz, input attenuator: 0 dB
		Residual response	≤–100 dBm (input attenuator: 0 dB, input: 50 Ω termination, 1 MHz to 3 GHz)
	Total level accuracy		±1.3 dB (100 kHz to 3 GHz) Level measurement accuracy after calibration using internal calibration signal Total level accuracy: reference level accuracy (0 to –49.9 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, dBµV (e.m.f), W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 dBm 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 bamdwidth switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (1 kHz to 3 MHz) *After calibration, referenced to resolution bandwidth 3 kHz Input attenuator (RF ATT) 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 dB (0 to 70 dB) *After calibration, referenced to frequecy 100 MHz, input attenuator 10 dB
	Frequency response		±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, input attenuator 10 dB, temperature 18° to 28°C) ±1.5 dB (9 to 100 kHz, 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 10 dB to 50 dB)

(Continued)

Model		MS2661C
Amplitude	Scale Fidelity	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), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4 % of reference level Marker level resolution Log scale: 0.01 dB Linear scale: 0.02 % of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer level: –30 dBm) ≤–75 dBc (0.2 to 1.5 GHz, mixer level: –30 dBm) ≤–80 dBc (0.8 to 1 GHz, mixer level: –30 dBm) 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 100 MHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm) ≤–80 dBc (0.1 to 3 GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximam dynamic range	1 dB gain compression level vs. average noise level: >110 dB (100 MHz to 1 GHz) >110 –f[GHz]dB (>1 GHz) when Option08 pre-amplifier installed: >109 dB (100 MHz to 1 GHz) >109 –1.5f[GHz]dB (>1 GHz) Distortion characterristics (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) >82.5 –f[GHz]dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz) >83.3 dB (100 to 1000 MHz) >83.3 –(2/3)f[GHz]dB (1 to 3 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 s to 1000 s), ±1 % (digital zero span mode)
	Sweep mode	Continious, single
	Sweep mode in time domain	Analog zero span,digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracking peak points within zone marker (zone sweep also possible)
Functions	Numbers of 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 uncertaity: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size 5.5", Number of colors: 17 (RGB, each 64-scale settable), Brightness: 5-scale settable
	Display function	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: Display 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+DL→A
	Storage functions	NORMAL, VIEW, MAX HOLD, AVERAGE, CUMULATIVE, OVERWRITE

(Continued)

	Model	MS2661C
Functions	FM demodulation waveform display	Setting range: 2, 5, 10, 20, 50, 100, 200 kHz/div Accuracy: –5 % of full scale (referenced to center frequency after calibration, DC-coupled, RBW 3 MHz, VBW 1 Hz, CW) Frequency response (3 dB): DC (50 Hz at AC coupled) to 100 kHz (range †20 kHz/div, VBW off), DC (50 Hz at AC coupled) to 500 kHz (range ‡50 kHz/div, VBW off) *Usable RBW: ‡1 kHz
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, 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	Numbers 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, dBm/Hz), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, REF: reference level method, REF: inband method, channel designate display: 2 channels × 2, graphic diplay), 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 limits × each 2, frequency domain)
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max.12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible model): Display data can be hard-copied via the RS232C, GPIB, or Centoronics (Option10) interface Plotter (HP-GL,GP-GL compatible models): Display data can be hard-copied via the RS232C or GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Progamming: Using editor of external computer Progamming memory: Memory card, upload/download to/from external computer Progamming capacity: 192 kbytes Data processing: Directly accesses measurement data according to sysytem variables, system subroutines, and system functions
	RS-232C	Output data to printer or plotter. Control from external computer (excluding power switch)
	GPIB interface	Functions: Meets IEEE488.2, Can be controlled as device from external controller (excluding power switch), or can control external equipment as controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Memory card interface	Functions: Save/recall measurement settings and data, uploads/downloads PTA programs, access SRAM, EPROM and flash EEPROM (can write to SRAM only), Supports cards up to 2 MB Connector: PCMCIA Ver.2.0 2 slots
	Correction	Autocorrection of MA1621A impedance transformer 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) Antenna factor Indication of the correction waveform data by antenna factor of a designated antenna and measurement of field strength (dB V/m) Built-in antenna factor Dipole antenna: MP534A/MP651A Log-Periodic Antenna: MP635A/MP666A Loop Antenna: MP414B User: Programmable through GPIB or RS-232C or PTA (4 types) Saving/Loading to/from Memory card possible
Others	Conducted disturbance	Meets EN 61326-1: 2006 (Class A)
	Radiated disturbance	Meets EN 61326-1: 2006 (Class A)
	Harmonic Current Emission	Meets EN 61000-3-2: 2006 (Class A)
	Electrostatic Discharge	Meets EN 61326-1: 2006 (Table 2)
	Electromagnetic Field Immunity	Meets EN 61326-1: 2006 (Table 2)
	Fast Transient / Burst	Meets EN 61326-1: 2006 (Table 2)
	Surge	Meets EN 61326-1: 2006 (Table 2)
	Conducted RF	Meets EN 61326-1: 2006 (Table 2)
	Power Frequency Magnetic Field	Meets EN 61326-1: 2006 (Table 2)
	Voltage Dips / Short Interruptions	Meets EN 61326-1: 2006 (Table 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132 / 170 to 250 V (automatic voltage switching), 47.5 to 63 Hz/380 to 420 Hz (85 to 132 V only), †330 VA
	Dimensions and mass	320 (W) × 177 (H) × 351 (D), †10.8 kg(without option)
	Ambient temperature	0¡ to 50¡C (operate), —40¡ to + 75¡C (storage)

(Continued)

Model			MS2663C
Frequency	Frequency range		9 kHz to 8.1 GHz
	Frequency band		Band 0 (0 to 3.2 GHz), band 1– (2.92 GHz to 6.5 GHz), band 1+ (6.4 GHz to 8.1 GHz)
	Pre-selector range		2.92 GHz to 8.1 Ghz (band 1–, band 1+)
	Frequency readout accuracy		± (frequency readout × reference frequency accuracy + span × span accuracy +100 Hz) *Span: ≥10 kHz, after calibration
	Marker frequency readout accuracy		Normal: Same as frequency readout accuracy, Delta: Same asfrequency span accuracy
	Frequency counter		Resolutions: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Frequency readout × reference frequency accuracy ±1 LSD (when S/N is 20 dB)
	Frequency span		Setting range: 0 Hz, 1 kHz to 8.2 GHz Accuracy: ±2.5 % (span ≥10 kHz), ±5 % (span ≤10 kHz, Option02 installed)
	Resolution bandwidth (RBW) (3 dB BW)		Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 Mhz (manually or automatically settable according to frequency span) *Option02: 30 Hz, 100 Hz, 300 Hz are added. Measurements of such as noise , C/N, adjacent channel leakage power by measure function are executed with the caluculated equivalent noise band width of the resolution band width. Accuracy: ±20 % (RBW=1 kHz to 1 MHz), ±30 % (RBW=3 MHz) Selectivity (60 dB:3 dB): ≤15:1
	Video bandwidth (VBW)		1Hz to 3 MHz (1-3 sequence), off *manually or automatically settable according to resolution bandwidth
	Signal purity and stability		Noise sidebands: ≤–100 dBc/Hz (1 GHz,10 kHz offset)
			Residual FM: ≤20 Hzp-p/0.1 sec (1 GHz, span=0 Hz) Frequency drift: ≤200 Hz/min (span ≤10 kHz, sweep time ≤100 sec)*After 1-hour warm-up at constant ambient temperature
	Reference oscillator		Frequency: 10 MHz Aging rate: (typical); Option01: 1×10^{-7}/year, 2×10^{-8}/day Temperature characterristics: 1×10^{-5} (typical, 0°C to 50°C); Option01: $\pm 5 \times 10^{-8}$ (0°C 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	≤–115 dBm (1 MHz to 1 GHz, band 0) ≤–115 dBm + f[GHz]dB (1 to 3.1 GHz, band 0) ≤–115 dBm +0.5f [GHz]dB (2.92 to 8.1 GHz, band 1) When Option08 pre-amplifier installed: ≤–114 dBm (1 MHz to 1 GHz, band 0) ≤–114 dBm + 1.5f[GHz]dB (1 to 3.1 GHz, band 0) ≤–115 dBm +0.5fdB (2.92 to 8.1 GHz, band 1) *Resolution bandwidth: 1 kHz, video bandwidth: 1 Hz, input attenuator: 0 dB, f: frequency [GHz]
		Residual response	≤–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 GHz), ±2.3 dB (2.92 to 8.1 GHz) Level measurement accuracy after calibration using internal calibration signal Total level accuracy: reference level accuracy (0 to –49.9 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, dBµV (e.m.f), W, dBµV/m Linear scale: V Reference level accuracy: ±0.4dB (–49.9 dBm 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 bamdwidth switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (1 kHz to 3 MHz) *After calibration, referenced to resolution bandwidth 3 kHz Input attenuator (RF ATT) 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 dB (0 to 70 dB) *After calibration, referenced to frequecy 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 (2.92 to 8.1 GHz, band 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, referenced to 100 MHz, input attenuator 10 dB to 50 dB) ±3.0 dB (2.92 to 8.1 GHz, band 1, referenced to 100 MHz, input attenuator 10 dB to 50 dB) *At band 1, after pre-selector tuning

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Model		MS2663C
Amplitude	Scale Fidelity	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), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±1.0 dB (0 to –90 dB) Linear scale: ±4 % of reference level Marker level resolution Log scale: 0.01 dB Linear scale: 0.02 % of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer level: –30 dBm) ≤–75 dBc (0.2 to 1.3 GHz, band 0, mixer level: –30 dBm) ≤–70 dBc (1.3 to 1.55 GHz, band 0, mixer level: –30 dBm) ≤–80 dBc (0.8 to 1 GHz, mixer level: –30 dBm) ≤–100dBc (1.46 to 4.05 GHz, band 1, mixer level: –20 dBm) 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 100 MHz frequency difference of two signal :≥50 kHz, mixer level: –30 dBm) ≤–80 dBc (0.1 to 8.1GHz frequency difference of two signal: ≥50 kHz, mixer level: –30 dBm)
		Image response: ≤–70 dBc Multiple respose: ≤–70 dBc
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximam dynamic range	1 dB gain compression level vs. average noise level: >110 dB (100 MHz to 1 GHz, band0) >110 –1.5f[GHz]dB (1 to 3.1 GHz, band0) >110 –0.5f[GHz]dB (2.92 to 8.1 GHz, band1) Distortion characterristics (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, band0) >82.5 –0.75f[GHz]dB (0.8 to 1 GHz, band0) >77.5 –0.75f[GHz]dB (1.3 to 1.55 GHz, band0) >97.5 –0.25f[GHz]dB (1.46 to 4.05 GHz, band1) 3rd order intermodulation: >80 dB (10 to 100 MHz) >83.3 dB (0.1 to 1 GHz) >83.3 –f[GHz]dB (1 to 3.1 GHz, band0) >83.3 –(1/3)f[GHz]dB (1.46 to 8.1 GHz, band1)
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 s to 1000 s), ±1 % (digital zero span mode)
	Sweep mode	Continious, single
	Sweep mode in time domain	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracking peak points within zone marker (zone sweep also possible)
Functions	Numbers of 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 uncertaity: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size 5.5", Number of colors: 17 (RGB, each 64-scale settable), Brightness:5-steps settable
	Display function	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: Display 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+DL→A
	Storage functions	NORMAL, VIEW, MAX HOLD, AVERAGE, CUMULATIVE, OVERWRITE

(Continued)

Model		MS2663C
Functions	FM demodulation waveform display	Setting range: 2, 5, 10, 20, 50, 100, 200 kHz/div Accuracy: –5 % of full scale (referenced to center frequency after calibration, DC-coupled, RBW 3 MHz, VBW 1 Hz, CW) Frequency response (3 dB): DC (50 Hz at AC coupled) to 100 kHz (range †20 kHz/div, VBW off), DC (50 Hz at AC coupled) to 500 kHz (range ‡50 kHz/div, VBW off) *Usable RBW: ‡1 kHz
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, 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	Numbers 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, dBm/Hz), occupied bandwidth (power N% method, X-dB down method), adjacent channel leakage power (REF: total power method, REF: reference level method, REF: inband method, channel designate display: 2 channels × 2, graphic diplay), 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 limits × each 2, frequency domain)
	Save/recall	Save and recall setting conditions and waveform data to internal memory (max.12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible model): Display data can be hard-copied via the RS232C, GPIB, or Centoronics (Option10) interface Plotter (HP-GL,GP-GL compatible models): Display data can be hard-copied via the RS232C or GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Progamming: Using editor of external computer Progamming memory: Memory card, upload/download to/from external computer Progamming capacity: 192 kbytes Data processing: Directly accesses measurement data according to sysytem variables, system subroutines, and system functions
	RS-232C	Output data to printer or plotter. Control from external computer (excluding power switch)
	GPIB interface	Functions: Meets IEEE488.2, Can be controlled as device from external controller (excluding power switch), or can control external equipment as controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Memory card interface	Functions: Save/recall measurement settings and data, uploads/downloads PTA programs, access SRAM, EPROM and flash EEPROM (can write to SRAM only), Supports cards up to 2 MB Connector: PCMCIA Ver.2.0 2 slots
	Correction	Autocorrection of MA1621A impedance transformer 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) Antenna factor Indication of the correction waveform data by antenna factor of a designated antenna and measurement of field strength (dB V/m) Built-in antenna factor Dipole antenna: MP534A/MP651A Log-Periodic Antenna: MP635A/MP666A Loop Antenna: MP414B User: Programmable through GPIB or RS-232C or PTA (4 types) Saving/Loading to/from Memory card possible
Others	Conducted disturbance	Meets EN 61326-1: 2006 (Class A)
	Radiation disturbance	Meets EN 61326-1: 2006 (Class A)
	Harmonic Current Emission	Meets EN 61000-3-2: 2006 (Class A)
	Electrostatic Discharge	Meets EN 61326-1: 2006 (Table 2)
	Electromagnetic Field Immunity	Meets EN 61326-1: 2006 (Table 2)
	Fast Transient / Burst	Meets EN 61326-1: 2006 (Table 2)
	Surge	Meets EN 61326-1: 2006 (Table 2)
	Conducted RF	Meets EN 61326-1: 2006 (Table 2)
	Power Frequency Magnetic Field	Meets EN 61326-1: 2006 (Table 2)
	Voltage Dips / Short Interruptions	Meets EN 61326-1: 2006 (Table 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132 / 170 to 250 V (automatic voltage switching), 47.5 to 63 Hz/380 to 420 Hz (85 to 132 V only), †330 VA
	Dimensions and mass	320 (W) × 177 (H) × 351 (D), †13.5 kg(without option)
	Ambient temperature	0¡ to 50¡C (operate), —40¡ to + 75¡C (storage)

● Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1×10^{-7}/year, ≤2×10^{-8}/day (referenced to 24 hours warmup)
Temparature stability	±5×10^{-8}/ (0° to 50°C, referenced to 25°C)
Buffered output	BNC connector, 10 MHz, >2 Vp-p (200 Ω terminated)

● Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (referenced to 3 kHz)
Bandwidth accuracy (MS2661C/MS2663C only)	±20 % (RBW=100 Hz, 300 Hz)
Selectivity (60 dB:3 dB)	≤15:1 (RBW=100 Hz, 300 Hz) ≤20:1 (RBW=30 Hz)

● 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 readout resolution	Log scale: 0.1 dB Linear scale: 0.2 % of Reference Level

● Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (Resolution: 0.1 V) Trigger slope: RISE/FALL Connector: BNC
	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: 47.5 to 63 Hz (Line lock)
	TV	System: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC (ODD/EVEN) Sync line: NTSC: H-SYNC (ODD): Line 7 to 262 H-SYNC (EVEN): Line 1 to 263 PAL: H-SYNC (ODD):Line 1 to 312 H-SYNC (EVEN):Line 317 to 625 *Option16, 21 required
Trigger delay	Pre-trigger	Displays waveform from previous max. 1 screen at trigger occurrence point Range: –Time Span to 0S 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 (Sound monitor)

Sound output	When internal loud speaker and earphone connctor (Φ3.5 mini jack), adjustable volume

● Option 08: Pre-amplifier

Model	MS2651B/61B/61C	MS2663C
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) ≤9 dB (typical value <2 GHz, with Option 22) ≤14 dB (typical value ≥2 GHz, with Option 22)	≤8 dB (<2 GHz) ≤13 dB (≥2 GHz, typical value)
Amplitude Level measurement Measurement range Maximum input level Average noise level	 Average noise level to 10 dBm +10 dBm (CW average power, input attenuator ≥10 dB), ±50 Vdc MS2651B: ≤–130 dBm (1 MHz to 1 GHz) ≤–130 dBm +1.5f[GHz]dB (>1 GHz) MS2661B/C: ≤–134 dBm (1 MHz to 1 GHz) ≤–134 dBm +2f[GHz]dB (>1 GHz) ≤–132 dBm (1 MHz to 1 GHz, with Opton 22) ≤–132 dBm +2f[GHz]dB (>1 GHz, with Option 22) *Resolution bandwidth 1 kHz,Video bandwidth 1 Hz, Input attenuator 0 dB	 ≤–132 dBm (1 MHz to 1 GHz) ≤–132 dBm +2f[GHz]dB(>1 GHz) *Resolution bandwidth 1 kHz, Video bandwidth 1 Hz, Input attenuator 0 dB
Reference Level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV 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 1 MHz, (When Input attenuator, Resolution bandwidth, Video bandwidth, and Sweep time set to AUTO.) Resolution bandwidth switching uncertainty: ±0.5 dB *After calibration, referenced to resolution bandwidth 3 kHz Input attenuator switching uncertainty: ±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 10 dB to 50 dB) ±2.0 dB (with Option 22, 100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT:10dB, 18° to 28 °C	
Scale Fidelity	Log scale: ±0.5 dB (0 to –20 dB),±1 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB 10MHz to 2.5 GHz with Option 22) Linear scale: ±5 % of Reference Level	
Spurious response	3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz) 10 MHz to 2.5 GHz with Option 22 *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 10: Centronics interface

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

● Option 12: QP detector* (MS2661B/MS2663B/MS2661C/MS2663C only)

Function	QP detector When this option is mounted, RBW=100 Hz 3 dB bandwidth of Option02 is modified to 150 Hz (representedative value) for MS2661B/MS2663B.		
6 dB Bandwidth	Bandwidth: 200 Hz,9 kHz,120 kHz Accuracy: ±30 %(18° to 28°C)		
Display	Log scale, 5 dB/div, 10 scale marks Linearity: ≤±2.0 dB/0 to –40 dB (CW signal, Reference Level=–60 dBµV, Input attenuator=0 dB, 18° to 28°C)		
Pulse response	Response corresponding to CISPR pulse (at DET mode: QP, 18° to 28°C)	Repeatition Frequency	Response
	120 kHz Bandwidth	1 kHz	–8.0 dB±1.0 dB
		100 Hz	Reference
		20 Hz	+9.0 dB±1.0 dB
		10 Hz	+14.0 dB±1.5 dB
		2 Hz	+26.0 dB±2.0 dB
		1 Hz	+28.5 dB±2.0 dB
	9 kHz Bandwidth	1 kHz	–4.5 dB±1.0 dB
		100 Hz	Reference
		20 Hz	+6.5 dB±1.0 dB
		10 Hz	+10.0 dB±1.5 dB
		2 Hz	+20.5 dB±2.0 dB
		1 Hz	+22.5 dB±2.0 dB
	200 Hz Bandwidth	100 Hz	–4.0 dB±1.0 dB
		60 Hz	–3.0 dB±1.0 dB
		25 Hz	Reference
		10 Hz	+4.0 dB±1.0 dB
		5 Hz	+7.5 dB±1.5 dB
		2 Hz	+13.0 dB±2.0 dB
		1 Hz	+17.0 dB±2.0 dB
QP ON/OFF Switching uncertainty	≤±1.0 dB (PEAK, QP) (CW signal, at Reference Level to –40 dB, at 18° 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/MP651A Log-Periodic Antenna : MP635A/MP666A Loop Antenna : MP414B Use : Programmable through GPIB or RS232C (4 types) Saving/Loading to/from Memory Card possible		

* Used of Option02 at the same time is necessary

● Option 13: QP detector* (MS2651B/MS2653B only)

Function	QP detector		
6 dB Bandwidth	Bandwidth: 9 kHz,120 kHz Accuracy: ±30 %(18° to 28°C)		
Display	Log scale, 5 dB/div, 10 scale marks Linearity: ≤2.0 dB/0 to –40 dB (CW signal, Reference Level=–60 dBµV, Input attenuator=0 dB, 18° to 28°C)		
Pulse response	Response corresponding to CISPR pulse (at DET mode: QP, 18° to 28°C)		
		Repeatition Frequency	Response
	120 kHz Bandwidth	1 kHz	–8.0 dB±1.0 dB
		100 Hz	Reference
		20 Hz	+9.0 dB±1.0 dB
		10 Hz	+14.0 dB±1.5 dB
		2 Hz	+26.0 dB±2.0 dB
		1 Hz	+28.5 dB±2.0 dB
	9 kHz Bandwidth	1 kHz	–4.5 dB±1.0 dB
		100 Hz	Reference
		20 Hz	+6.5 dB±1.0 dB
		10 Hz	+10.0 dB±1.5 dB
		2 Hz	+20.5 dB±2.0 dB
		1 Hz	+22.5 dB±2.0 dB
QP ON/OFF Switching uncertainty	≤±1.0 dB (PEAK, QP) (CW signal, at Reference Level to –40 dB, at 18° 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/MP651A Log-Periodic Antenna : MP635A/MP666A Loop Antenna : MP414B Use : Programmable through GPIB or RS232C (4 types) Saving/Loading to/from Memory Card possible		

● Option 14: PTA PARALLEL I/O*

<table>
<tr><td>Function</td><td>Controlling external equipment from PTA</td></tr>
<tr><td>System variables</td><td>The following controls are possible using PTA system variables:
<table>
<tr><th>System variable</th><th>Control description</th></tr>
<tr><td>IOA</td><td>Control of 8 bits parallel output port A</td></tr>
<tr><td>IOB</td><td>Control of 8 bits parallel output port B</td></tr>
<tr><td>IOC</td><td>Control of 8 bits parallel I/O port C</td></tr>
<tr><td>IOD</td><td>Control of 8 bits parallel I/O port D</td></tr>
<tr><td>EIO</td><td>Control of I/O switching port C and D</td></tr>
<tr><td>EXO</td><td>Control of trigger (I/O)</td></tr>
</table></td></tr>
<tr><td>PTL statements</td><td>Using PTA PTL statements allows control of interrupts input externally to the I/O ports
<table>
<tr><th>PTL statement</th><th>Control description</th></tr>
<tr><td>IOEN statement</td><td>Allow interrupt input</td></tr>
<tr><td>IODI statement</td><td>Prohibit interrupt input</td></tr>
<tr><td>IOMA statement</td><td>Masks interrupt input</td></tr>
<tr><td>ON TO GOTO statement</td><td>Changes program flow when interrupt occurs</td></tr>
<tr><td>ON TO GOSUB statement</td><td>Changes program flow when interrupt occurs</td></tr>
</table></td></tr>
<tr><td>Write strobe signal</td><td>Outputs a write strobe pulse (negative pulse) to an external unit when output port C or D is controlled</td></tr>
<tr><td>DC output</td><td>Supplies +5 V ±0.5 V (max. 100 mA) power for external equipment use</td></tr>
<tr><td>Signal logical level</td><td>Negative logic, TTL level
Rated current:
Output ports A, B:Max.output current Hi: 2.6 mA, Lo: 24 mA
Output ports C, D:Max.output current Hi: 15 mA, Lo: 24 mA
Other control output lines :Max. output current Hi: 0.4 mA, Lo: 8 mA</td></tr>
<tr><td>Cable connector</td><td>Amphenol 36 pins</td></tr>
<tr><td>Connector pin layout</td><td>
<table>
<tr><th>Pin No.</th><th>Name</th><th>Pin No.</th><th>Name</th></tr>
<tr><td>1</td><td>GND</td><td>19</td><td>Output port B (6)</td></tr>
<tr><td>2</td><td>Trigger input</td><td>20</td><td>Output port B (7) MSB</td></tr>
<tr><td>3</td><td>Trigger output1</td><td>21</td><td>I/O port C (0) LSB</td></tr>
<tr><td>4</td><td>Trigger output2</td><td>22</td><td>I/O port C (1)</td></tr>
<tr><td>5</td><td>Output port A (0) LSB</td><td>23</td><td>I/O port C (2)</td></tr>
<tr><td>6</td><td>Output port A (1)</td><td>24</td><td>I/O port C (3) MSB</td></tr>
<tr><td>7</td><td>Output port A (2)</td><td>25</td><td>I/O port D (0) LSB</td></tr>
<tr><td>8</td><td>Output port A (3)</td><td>26</td><td>I/O port D (1)</td></tr>
<tr><td>9</td><td>Output port A (4)</td><td>27</td><td>I/O port D (2)</td></tr>
<tr><td>10</td><td>Output port A (5)</td><td>28</td><td>I/O port D (3) MSB</td></tr>
<tr><td>11</td><td>Output port A (6)</td><td>29</td><td>Port C status 0/1:I/O</td></tr>
<tr><td>12</td><td>Output port A (7) MSB</td><td>30</td><td>Port D status 0/1:I/O</td></tr>
<tr><td>13</td><td>Output port B (0) LSB</td><td>31</td><td>Write strobe signal</td></tr>
<tr><td>14</td><td>Output port B (1)</td><td>32</td><td>Interrupt signal</td></tr>
<tr><td>15</td><td>Output port B (2)</td><td>33</td><td>(not used)</td></tr>
<tr><td>16</td><td>Output port B (3)</td><td>34</td><td>+5 V power supply</td></tr>
<tr><td>17</td><td>Output port B (4)</td><td>35</td><td>(not used)</td></tr>
<tr><td>18</td><td>Output port B (5)</td><td>36</td><td>(not used)</td></tr>
</table></td></tr>
</table>

* Not installed with Option10: Centronics interface

● Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kW 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

Video		M-NTSC, B/G/H PAL color
Audio		Simultaneous monitor of video and audio needs Option07: AM/FM demodulator
Function	Channel	CCIR, USA, Italy, Japan
	Trigger	Vsync, HSYNC (ODD), HSYNC (EVEN) line
	Aux.output	Composite video, BNC connector

● Option 19: DC coupled input*

Function		DC coupling the input circuits and expanding the lower limit of reception frequency to 500 Hz
Frequency Range		500 Hz to 3 GHz
Amplitude	Max input level	+30 dBm (CW average power, Input attenuator ≥10 dB), ±0 Vdc
	Average noise level	Resolution bandwidth: 30 Hz, Input attenuator: 0 dB, Video bandwidth: 1 Hz ≤–80 dBm (500 Hz to 10 kHz) ≤–90 dBm (10 kHz to 200 kHz) ≤–110 dBm (200 kHz to 1 MHz)
	Frequency response	±1.2 dB (500 Hz to 100 kHz) ±0.5 dB (100 kHz to 3 GHz)

* Use Option02 at the same time is necessary

● Option 20: Tracking generator

	MS2651B/61B/61C	MS2663C (*)
Frequency range	9 kHz to 3 GHz	
Output level range	0 to –60 dBm	
Output level resolution	0.1 dB	
Output level accuracy	±1.0 dB (at frequency 100 MHz, 0 dBm)	
Flatness	±1.5 dB (100 kHz to 3 GHz, 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) (100 kHz to 3 GHz, referenced to 0 dBm)	
Spurious	Harmonics ≤–20 dBc (output level 0 dBm, 100 kHz to 3 GHz) Non-harmonics ≤–35 dBc (output level 0 dBm, 100 kHz to 3 GHz)	Harmonics ≤–20 dBc (output level 0 dBm, 100 kHz to 3 GHz) Non-harmonics ≤–35 dBc (100 kHz to 2 GHz) ≤–30 dBc (2 to 3 GHz) (output level 0 dBm)
Tracking generator feed through	≤–95 dBm (RF input and TG output terminated 50 Ω)	
Output connector	N-J, 50 Ω	

(*) Not installed with Option 08: Pre-amplifier

● Option 21: Television monitor (multi-system)

Video		M-NTSC, B/G/H/D/I PAL color
Audio		Simultaneous monitor of video and audio needs Option07: AM/FM demodulator
Function	Channel	CCIR, USA, Italy, Japan, China, UK
	Trigger	Vsync, HSYNC (ODD), HSYNC (EVEN) line
	Aux.output	Composite video, BNC connector

● Option 22: 75 Ω Input (MS2651B/MS2661B/MS2661C only)

Model		MS2651B	MS2661B/MS2661C
Function		75 Ω Input Selectable tracking generator is opt. 23 75 Ω Tracking generator only.	
Frequency range		100 kHz to 2.5 GHz	
Amplitud	Measurement range	Average noise level to +25 dBm	
	Maximum input level	+25 dBm (RF ATT ≥10 dB), ±100 V	
	Residual response	≤–95 dBm (+13.8 dBμV) (RF ATT: 0 dB, Input: 75 Ω termination)	
	Total level accuracy	±1.8 dB (100 kHz to 2.5 GHz, T=18° to 28°C) *Level measurement accuracy after calibration using internal calibration signal. Total level accuracy: Reference level accuracy (0 to –49.9 dBm) +Frequency response +log linearity (0 to –20 dB)	
	Reference level	Setting range Log scale: +8.8 dBμV to +133.8 dBμV or equivalent level Linear scale: 274 μV to 4.87 V	
	Frequency response	±1.0 dB (100 kHz to 2.5 GHz) *Referenced to 100 MHz, RF ATT=10 dB, T=18° to 28°C	
	Spurious response	2nd harmonic distotion: (Mixer level: –30 dBm) ≤–55 dBc (10 to 100 MHz) ≤–60 dBc (0.1 to 1.25 GHz)	≤–60 dBc (10 to 200 MHz) ≤–75 dBc (0.2 to 1.25 GHz) ≤–80 dBc (0.8 to 1 GHz)
		3rd order intermodulation distotion: (Mixer level: –30 dBm, separation of two signals: ≥50 kHz) ≤–70 dBc (10 to 2500 MHz)	≤–70 dBc (10 to 100 MHz) ≤–80 dBc (0.1 to 2.5 GHz)
	Maximum dynamic range (RBW=1 kHz)	1 dB gain commpression level to average noise level: >105 dB (0.1 to 1 GHz) >105 dB –f[GHz]dB (>1 GHz)	>110 dB (0.1 to 1 GHz) >110 dB –f[GHz]dB (>1 GHz) When opt. 08 pre-amplifier is installed >109 dB (0.1 to 1 GHz) >109 dB –1.5f[GHz]dB (>1 GHz
		Distortion characteristics 2nd harmonic distotion: >67.5 dB (10 to 100 MHz) >70 dB (0.1 to 0.5 GHz) >70 dB –f[GHz]dB (0.5 to 1.25 GHz)	>72.5 dB (10 to 200 MHz) >80 dB (0.2 to 0.5 GHz) >80 dB –f[GHz]dB (0.5 to 1.25 GHz) >82.5 dB –f[GHz]dB (0.8 to 1 GHz)
		3rd order intermodulation distotion: >76.6 dB (10 to 100 MHz) >76.6 dB –2f[GHz]/3 dB (0.1 to 1.25 GHz)	>80 dB (10 to 100 MHz) >83.3 dB (0.1 to 1 GHz) >83.3 dB –2f[GHz]/3 dB (1 to 1.25 GHz)
Others	RF Connector	NC-J, 75 Ω	
	Video Output (Y)	Connector: BNC Level: (100 MHz Input, from lower edge to upper edge at 10 %/div and 10 dB/div, 75 Ω termination) Log scale: 0 to 0.5 V ±0.1 V nominal Linear scale: 0 to 0.4 V ±0.1 V nominal	

● Option 23: 75 Ω Input (MS2651B/MS2661B/MS2661C only)

Frequency range	100 kHz to 2.5 GHz
Output level	Setting range +44 dBµV to +104 dBµV Setting resolution 0.1 dB
Output level accuracy	±1.5 dB (100 MHz, +104 dBµV)
Flatness	±1.75 dB (referenced to 100 MHz, +104 dBµV)
Linearity	*referenced to +104 dBµV ≤1.0 dB (+74 dBµV) ≤2.0 dB (+44 dBµV to +74 dBµV)
Spurious	Harmonics: ≤–20 dBc Non-harmonics: ≤–30 dBc
TG feed through	≤+13.8 dBµV *RF Input and TG Output are terminated to 75 Ω termination
TG Output Connector	NC-J, 75 Ω

● Option 24: Television monitor (Brazil)

Video		M-NTSC, M PAL color
Audio		Simultaneous monitor of video and audio needs Option07: AM/FM demodulator
Function	Channel	CCIR, USA, Italy, Japan, China, UK
	Trigger	Vsync, HSYNC (ODD), HSYNC (EVEN) line
	Aux.output	Composite video, BNC connector

● Whether or not to mount options on the series devices

3 GHz Model

		Model					
		50 Ω			75 Ω (Option 22)		
Option No.	Name	MS2651B	MS2661B	MS2661C	MS2651B	MS2661B	MS2661C
01	Reference crystal oscillator	O	O	O	O	O	O
02	Narrow resolution bandwidth	×	O	O	×	O	O
04	High-speed time domain sweep	O	O	O	O	O	O
06	Trigger/gate circuit	O	O	O	O	O	O
07	AM/FM demodulator	O	O	O	O	O	O
08	Pre-amplifier	O	O	O	O	O	O
10	Centronics interface	O	O	O	O	O	O
12	QP detector (200 Hz, 9 kHz, 120 kHz)	×	O	O	×	O	O
13	QP detector (9 kHz, 120 kHz)	O	×	×	O	×	×
14	PTA parallel I/O	O	O	O	O	O	O
15	Sweep signal output	O	O	O	O	O	O
16	Television monitor	O	O	O	O	O	O
19	DC coupled input	×	O	O	×	O	O
20	Tracking generator	O	O	O	×	×	×
21	Television monitor (multi-system)	O	O	O	O	O	O
22	75 Ω input						
23	75 Ω Tracking generator	×	×	×	O	O	O
24	Television monitor (Brazil)	O	O	O	O	O	O

O: Can be mounted ×: Cannot be mounted

8 GHz Model

		Model		
		50 Ω		
Option No.	Name	MS2653B	MS2663B	MS2663C
01	Reference crystal oscillator	O	O	O
02	Narrow resolution bandwidth	×	O	O
04	High-speed time domain sweep	O	O	O
06	Trigger/gate circuit	O	O	O
07	AM/FM demodulator	O	O	O
08	Pre-amplifier	×	×	O
10	Centronics interface	O	O	O
12	QP detector (200 Hz, 9 kHz, 120 kHz)	×	O	O
13	QP detector (9 kHz, 120 kHz)	O	×	×
14	PTA parallel I/O	O	O	O
15	Sweep signal output	O	O	O
16	Television monitor	O	O	O
21	Television monitor (multi-system)	O	O	O
24	Television monitor (Brazil)	O	O	O

O: Can be mounted ×: Cannot be mounted

SECTION 2
PREPARATIONS BEFORE USE

This section explains the preparations and safety procedures that should be performed before using the MS2650/MS2660B/C 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/MS2660B/C series.
For connecting the GPIB cable and setting the GPIB address, see the Remote Control part of the separate Operation Manual Vol.3.

TABLE OF CONTENTS

SECTION 2
PREPARATIONS BEFORE USE

Installation Site and Environmental Conditions

Locations to be avoided

The MS2650/MS2660B/C 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

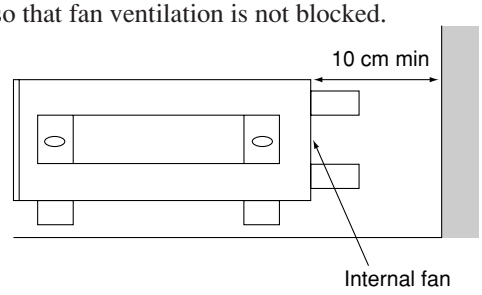
In addition to meeting the above conditions, to insure long-term trouble-free operation, the equipment should be used at room temperature and in a location where the power supply voltage does not fluctuate greatly.

CAUTION ⚠

If the MS2650/MS2660B/C 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/MS2660B/C series on until it has been allowed to dry out sufficiently.

Fan clearance

To suppress any internal temperature increase, the MS2650/MS2660B/C 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/MS2660B/C 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/MS2660B/C series and fire.
• During power-on	To maintain the MS2650/MS2660B/C 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/MS2660B/C 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/MS2660B/C 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 (MS2651B/2661B/2661C: standard) 9 kHz to 8.1 GHz (MS2653B/2663B/2663C)
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
Frequency range:	100 kHz to 2.5 GHz (MS2651B/2661B/2661C plus opt. 22 75 Ω:75 Ω)
Measurement level:	Apply the measured signal with average noise level up to +25 dBm to the NC-type connector RF Input of 75 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.
When the Option 22 is installed; if a signal exceeding +25 dBm, 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 AC 85 to 132 V, or AC 170 to 250 V (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 AC** V and *** A, respectively.*

To protect the operator, the following WARNING and CAUTION notices are attached to the rear panel of the MS2651B/MS2661B/MS2653B/MS2663B/MS2661C/MS2663C.

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.

Connecting the Power Cord

Check that the main power switch on the [Line] is turned off.

Insert the power plug into an outlet, and connect the other end to the power inlet on the rear panel. To ensure that the instrument is earthed, always use the supplied 3-pin power cord, and insert the plug into an outlet with an earth terminal.

WARNING ⚠

f the power cord is connected without the instrument earthed, there is a risk of receiving a fatal electric shock. In addition, the peripheral devices connected to the instrument may be damaged.

When connecting to the power supply, DO NOT connect to an outlet without an earth terminal. Also, avoid using electrical equipment such as an extension cord or a transformer.

CAUTION ⚠

If an emergency arises causing the instrument to fail or malfunction, disconnect the instrument from the power supply by either turning off the [Line] switch on the rear panel, or by pulling out the power cord or the power inlet.

When installing the instrument, place the instrument so that an operator may easily operate the [Line] switch.

If the instrument is mounted in a rack, a power switch for the rack or a circuit breaker may be used for power disconnection.

It should be noted that, the [Power] switch on the front panel of the instrument is a standby switch, and cannot be used to cut the main power.

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/MS2660B/C 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.

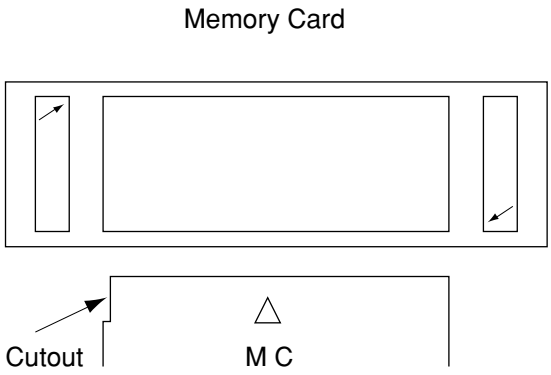
Step	Procedure
1	Set the front-panel [Power] switch to Stby and the rear-panel [Line] switch to OFF. Then, remove the power cord from the power-supply outlet.
2	Use a flat-bladed screwdriver to turn the fuse-holder cap counterclockwise. The cap and fuse are removed as a unit from the fuse holder.
3	Remove 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.

TABLE OF CONTENTS

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 Marking	Explanation of Function
1	(LCD)	This is a 5.5 ” 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 Marking	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 20/23 is not attached to, this key is not available.)
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 Marking	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.
21	RF Input	This is the RF input connector.
22	TG Output	This is the tracking generator output connector. (If Option 20/23 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	They are the input connector for an external reference crystal oscillator and the output connector of the 10 MHz Reference signal. 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.
53	Video (Y)	This connector output a Y-axis signal that is proportional to the video detection signal output and is logarithmically compressed at log scale.

No.	Panel Marking	Explanation of Function
54	Composite Out	This is the video composite signal output connector.
55	O/I	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	(Functional earth Terminal)	This is the terminal that is electrically connected to the chassis of the equipment.
58	RS-232C	This is the RS-232C connector. Connect it to an external system controller or printer, etc.
59	GPIB or Centronics	This connector is for use with a GPIB or Centornics (Option 10) interface. It is connected to an external system controller, or a printer etc.
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.)
64	Video (TV)	This is a output connector for a demodulated signal (composite signal) by the TV monitor. (If Option 16, 21, 24 is no attached to, this connector is not provided.
65	Name plate	This shows a production number and options.

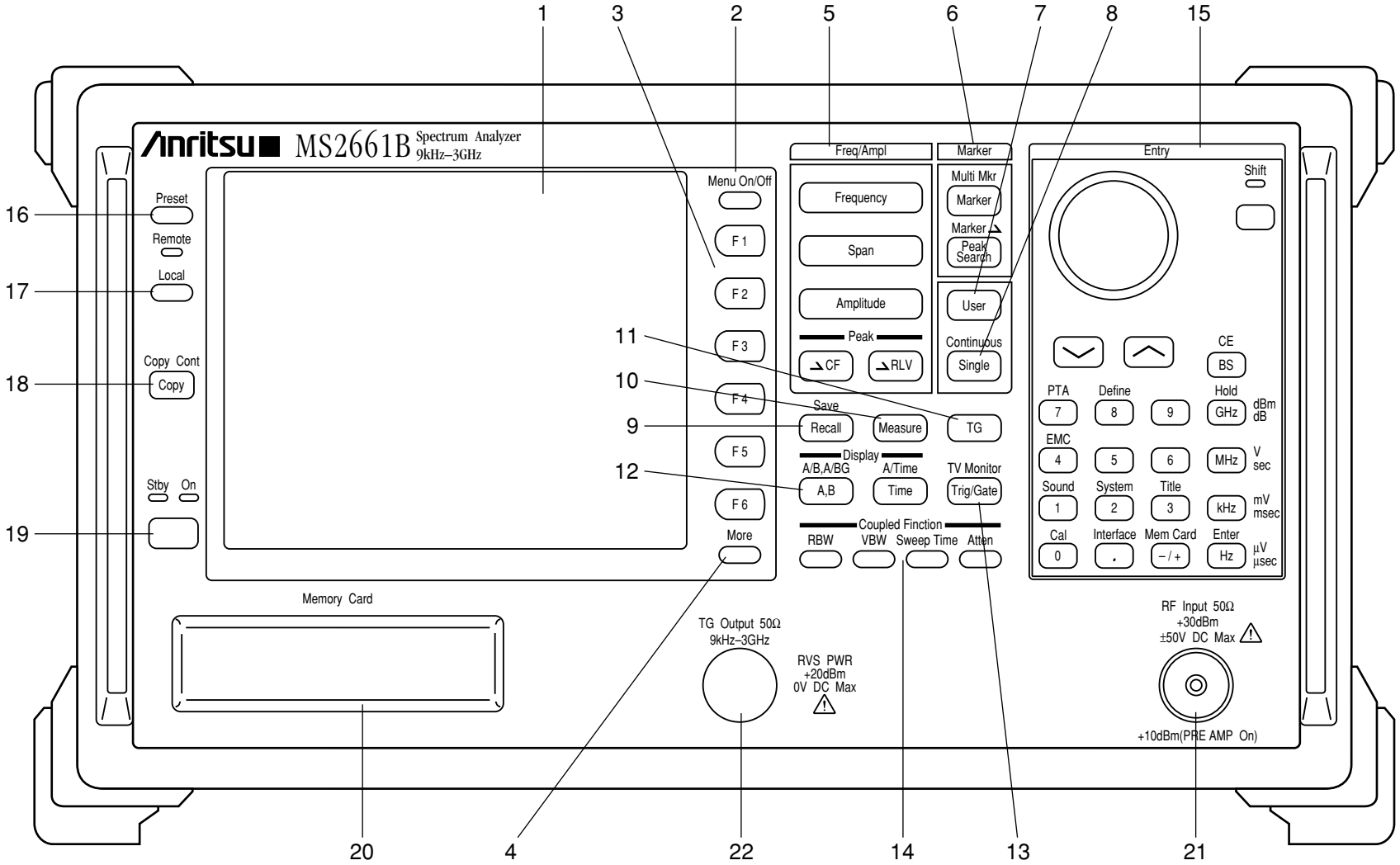
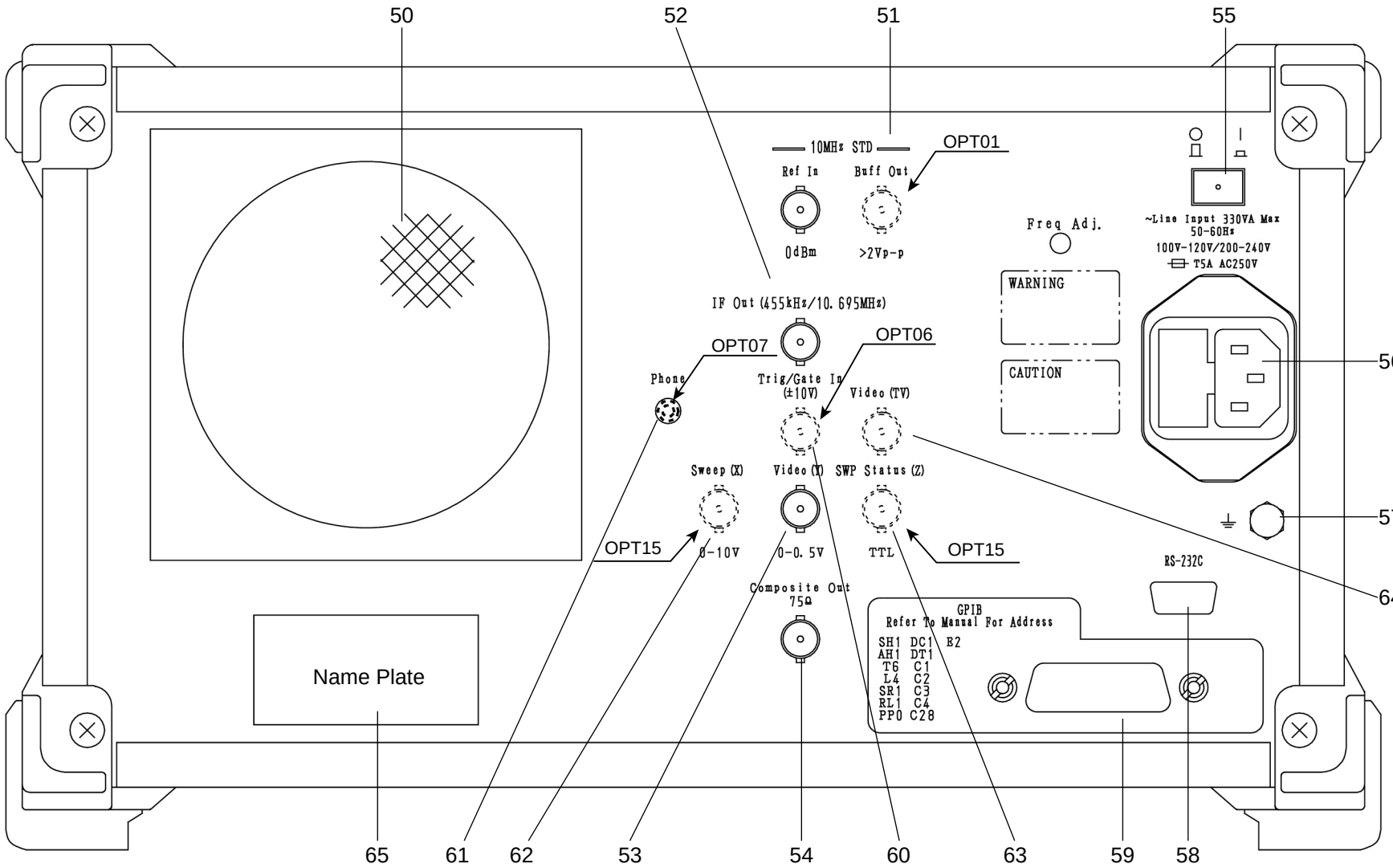


Fig. 3-1 Front Panel



*: For OPT10

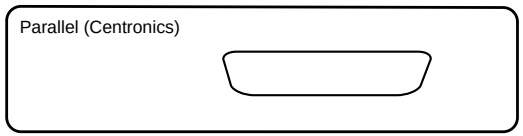


Fig. 3-2 Rear Panel

SECTION 4
SOFT-KEY MENU

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

TABLE OF CONTENTS

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.

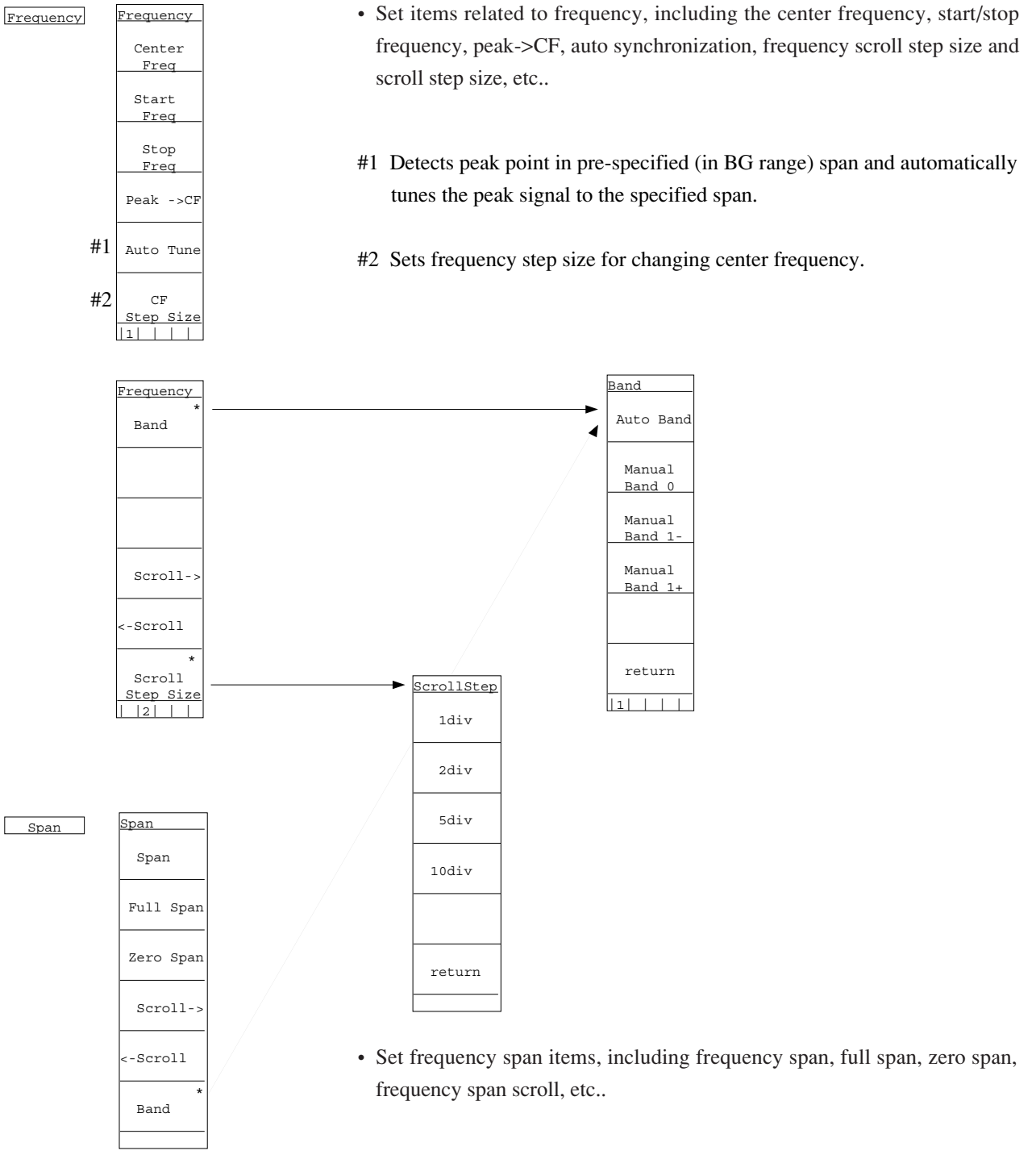
(7) Panel keys and soft keys prefixed by a sharp symbol (#) at the left of the menu frame, give an outline explanation of the function.

Soft-key Menu List

Menu Tree

Menu Tree (1 /28)

Panel Key — Top menu — Lower menues



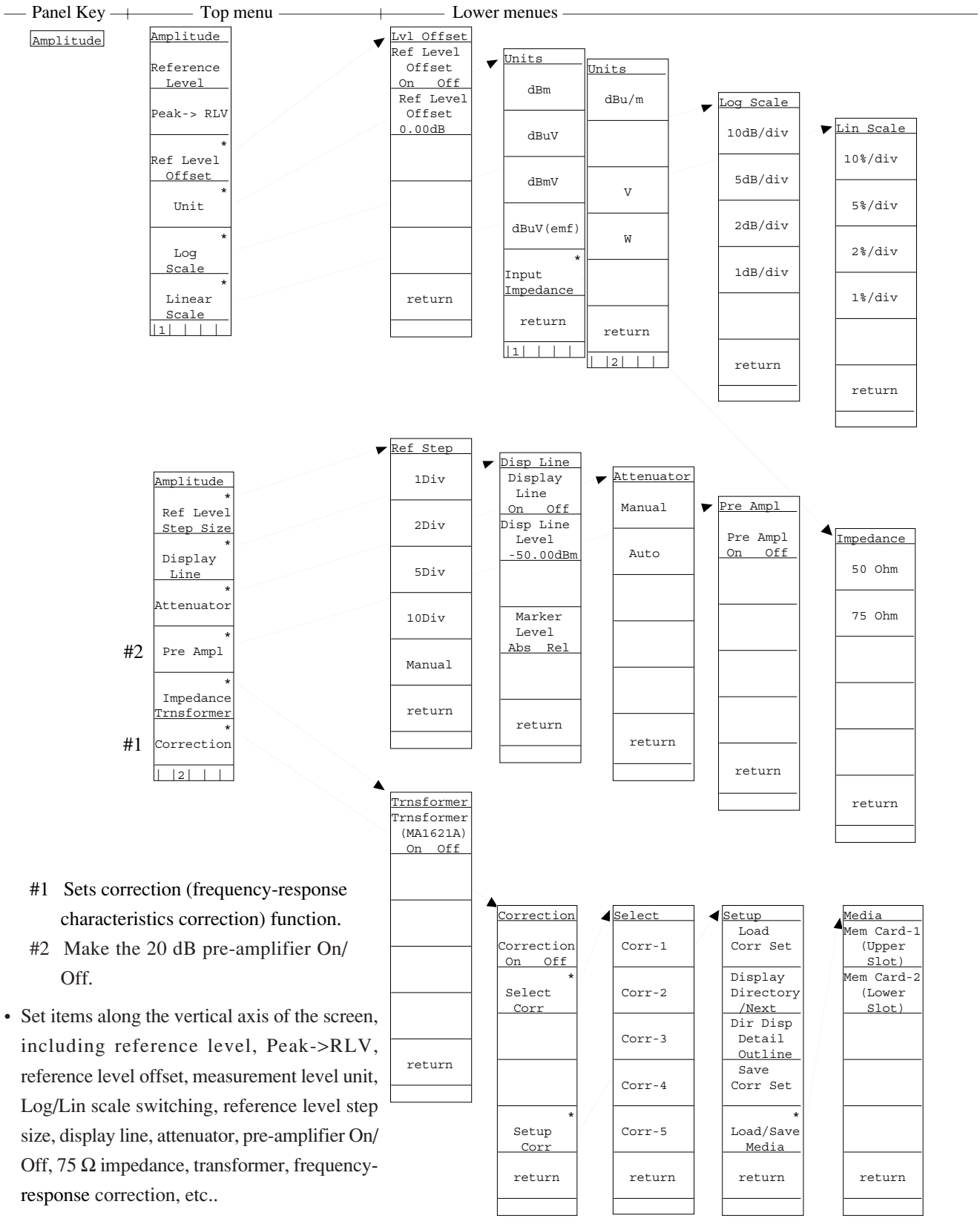
- Set items related to frequency, including the center frequency, start/stop frequency, peak->CF, auto synchronization, frequency scroll step size and scroll step size, etc..

#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/Span Ratio On Off
RB/Span Ratio 0.01
RB,VB,SWT Auto
#1 All Auto

- Set the manual/auto of resolution bandwidth, and auto (RBW, VBW and SWP only) or all auto.
- Set Ratio of RBW to Span when RBW is Auto and Ratio Mode is “on”.

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

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

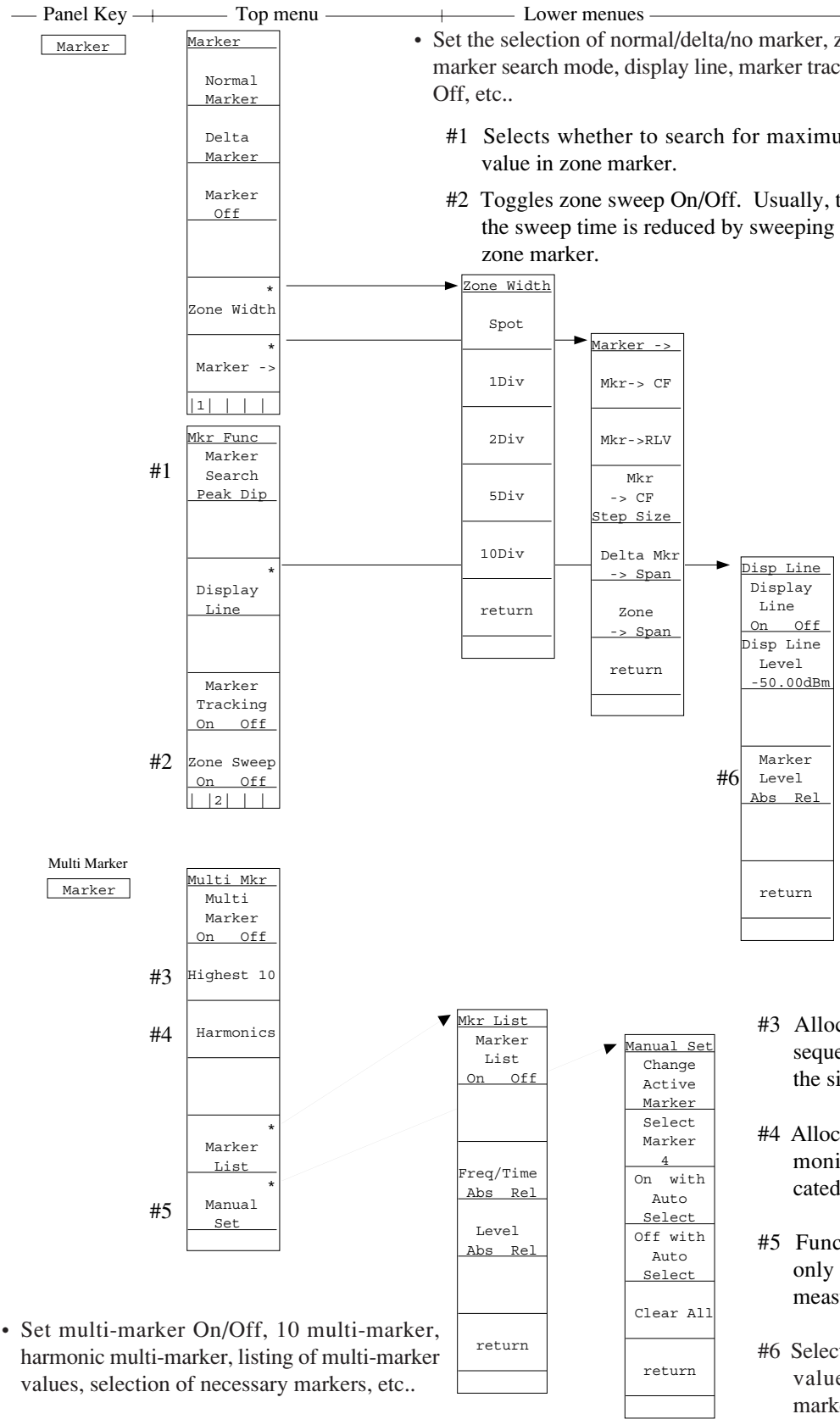
- Set the manual/auto of sweep time, and auto (RBW, VBW and SWP only) or all auto.

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.

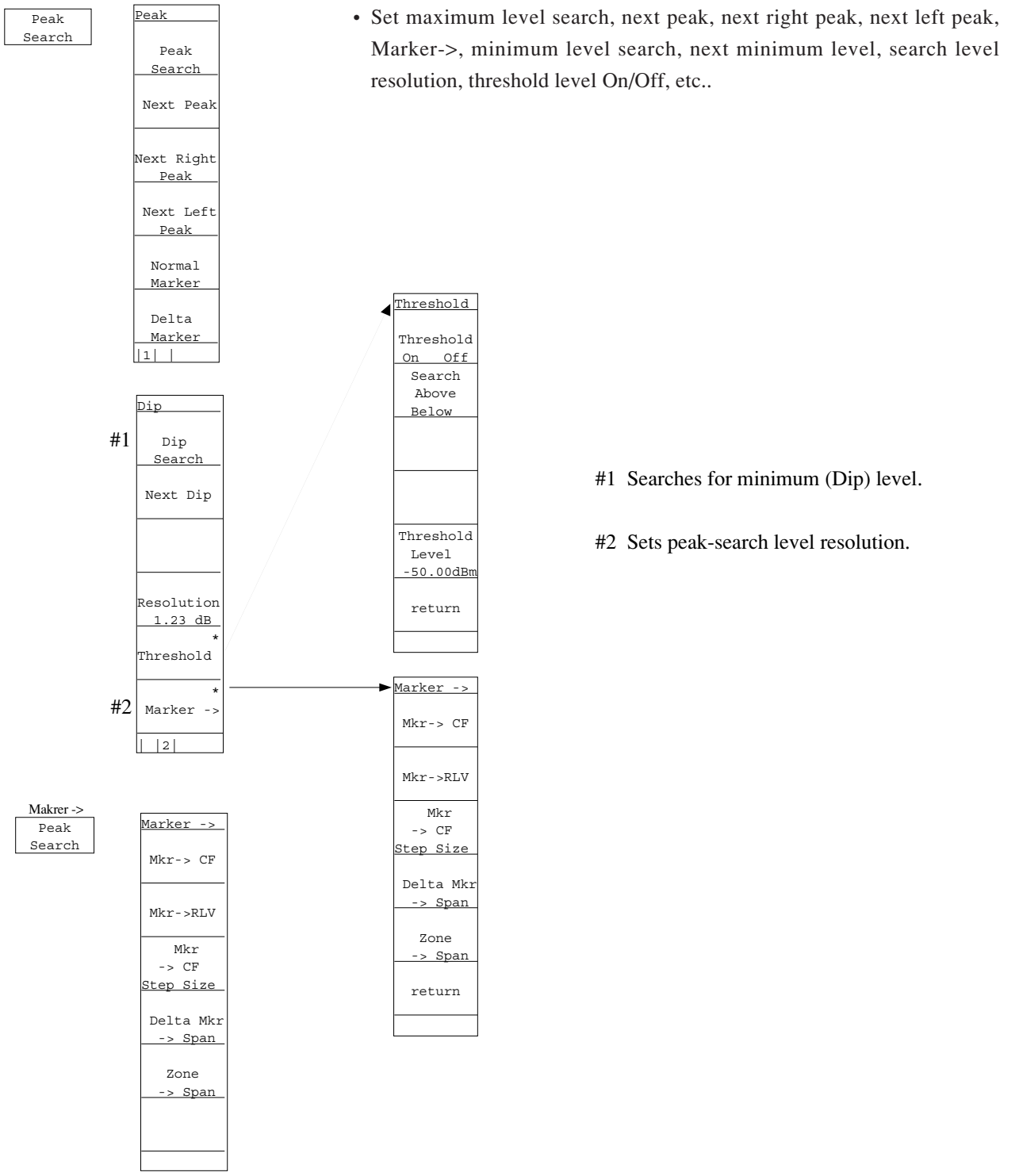
#4 Allocates multi-markers to the harmonic signals of frequency indicated by current marker.

#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



- 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..

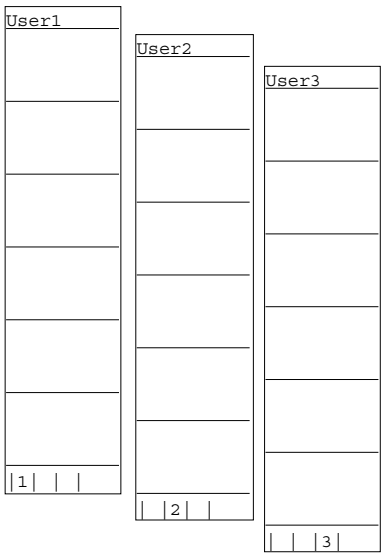
#1 Searches for minimum (Dip) level.

#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..

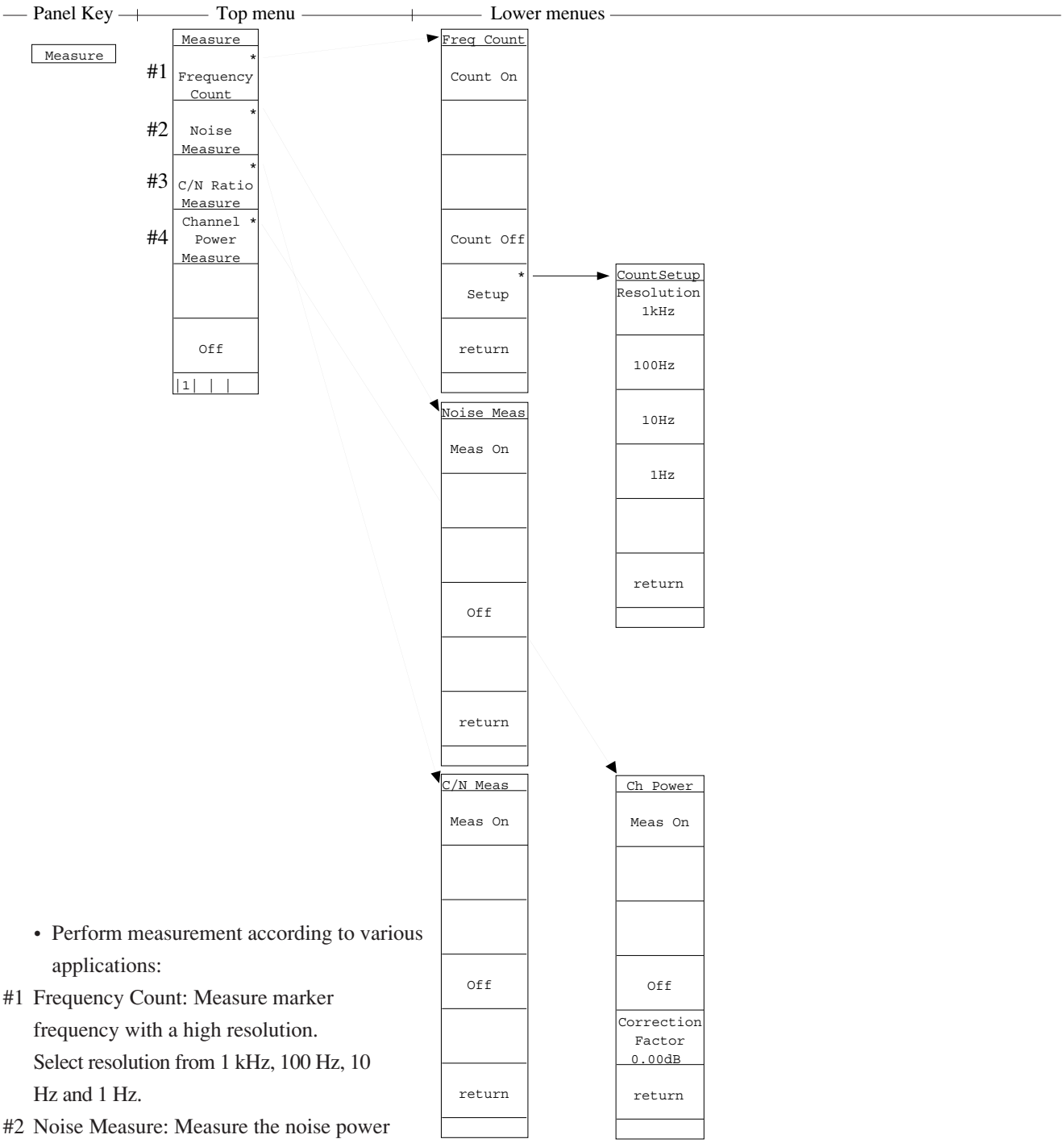
Menu Tree (6/28)

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:

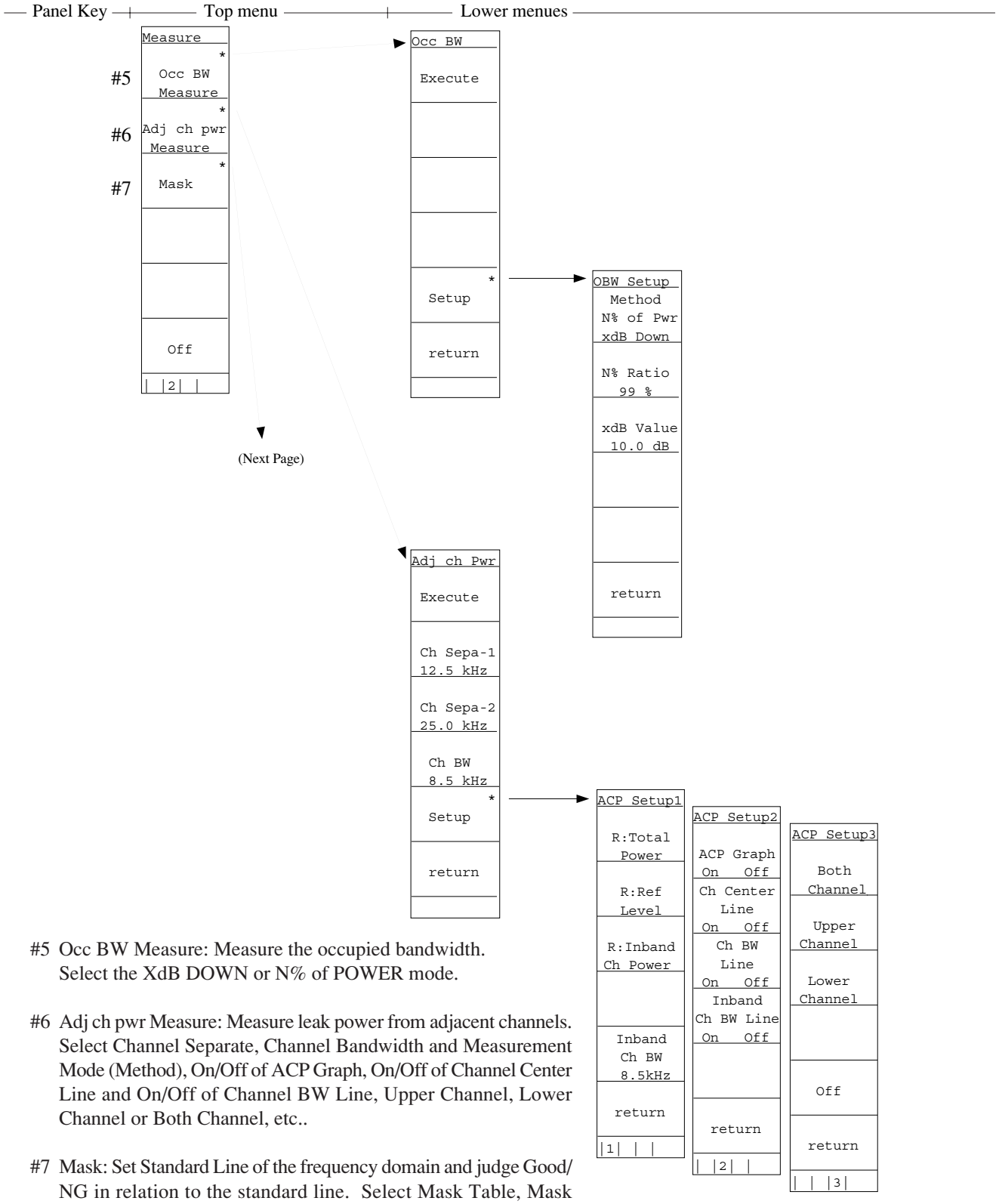
#1 Frequency Count: Measure marker frequency with a high resolution. Select resolution from 1 kHz, 100 Hz, 10 Hz and 1 Hz.

#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 marker is measured. It is possible to set an arbitrary calibration value.

Menu Tree (8/28)

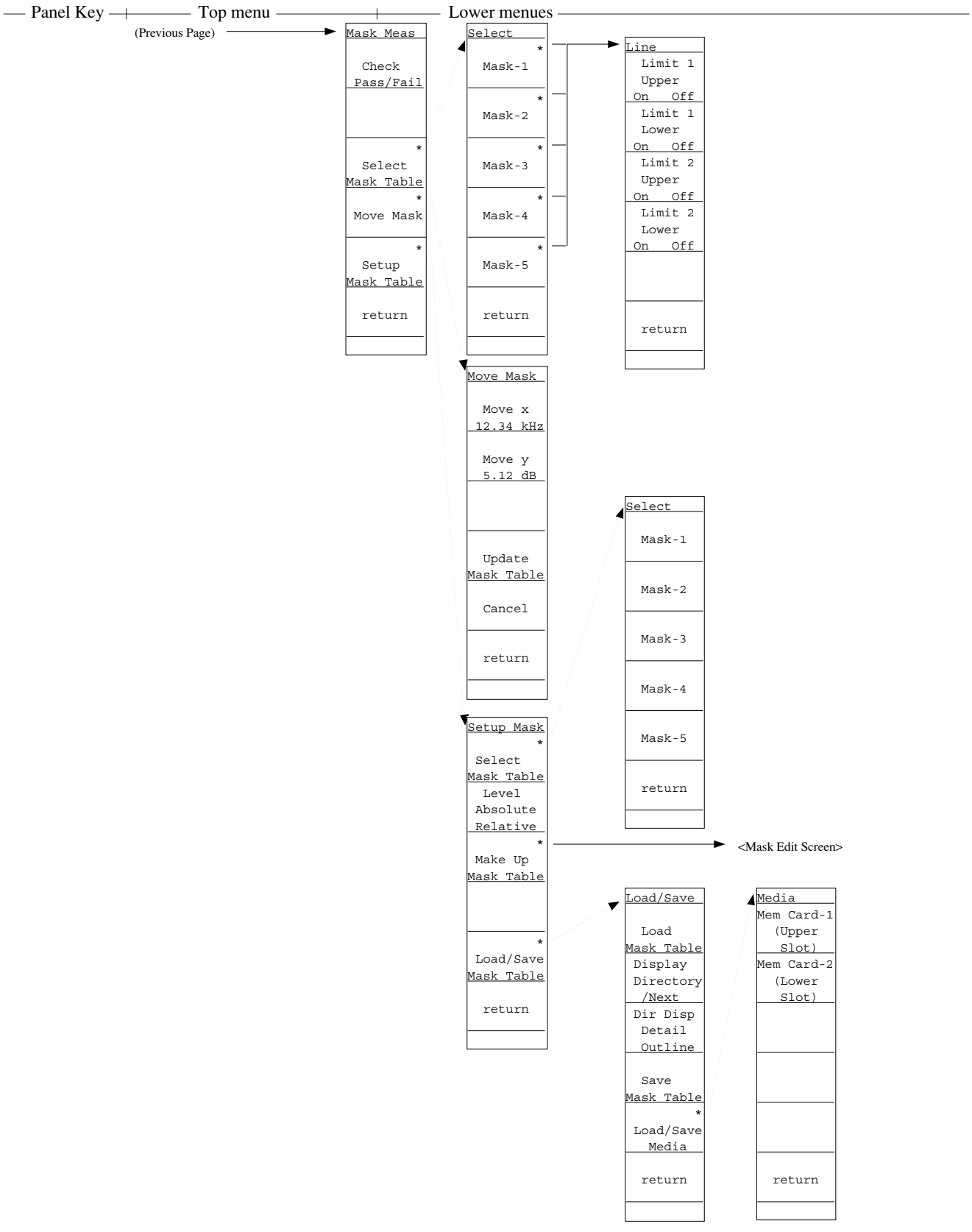


#5 Occ BW Measure: Measure the occupied bandwidth. Select the XdB DOWN or N% of POWER mode.

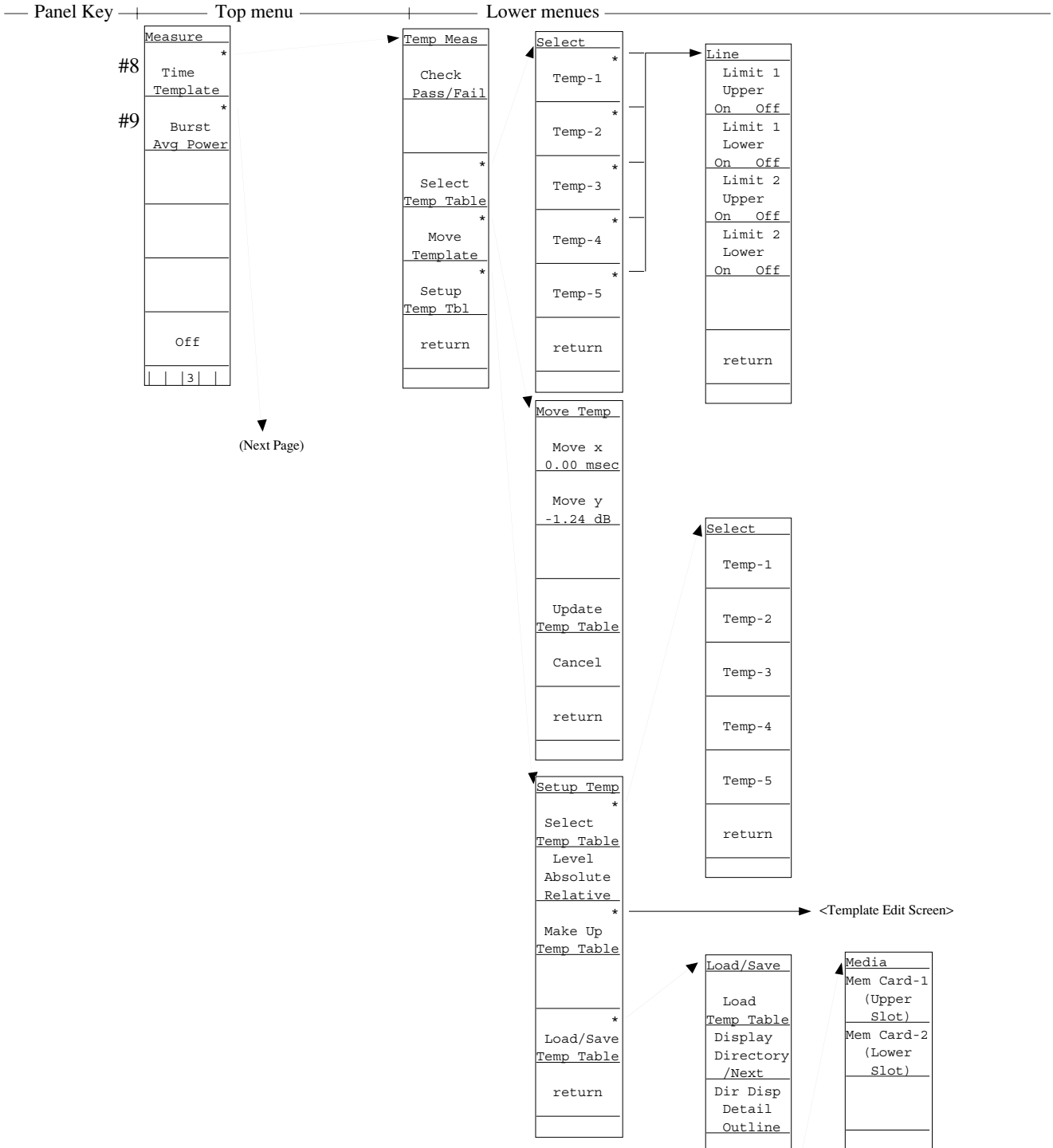
#6 Adj ch pwr Measure: Measure leak power from adjacent channels. Select Channel Separate, Channel Bandwidth and Measurement Mode (Method), On/Off of ACP Graph, On/Off of Channel Center Line and On/Off of Channel BW Line, Upper Channel, Lower Channel or Both Channel, etc..

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

Menu Tree (9/28)



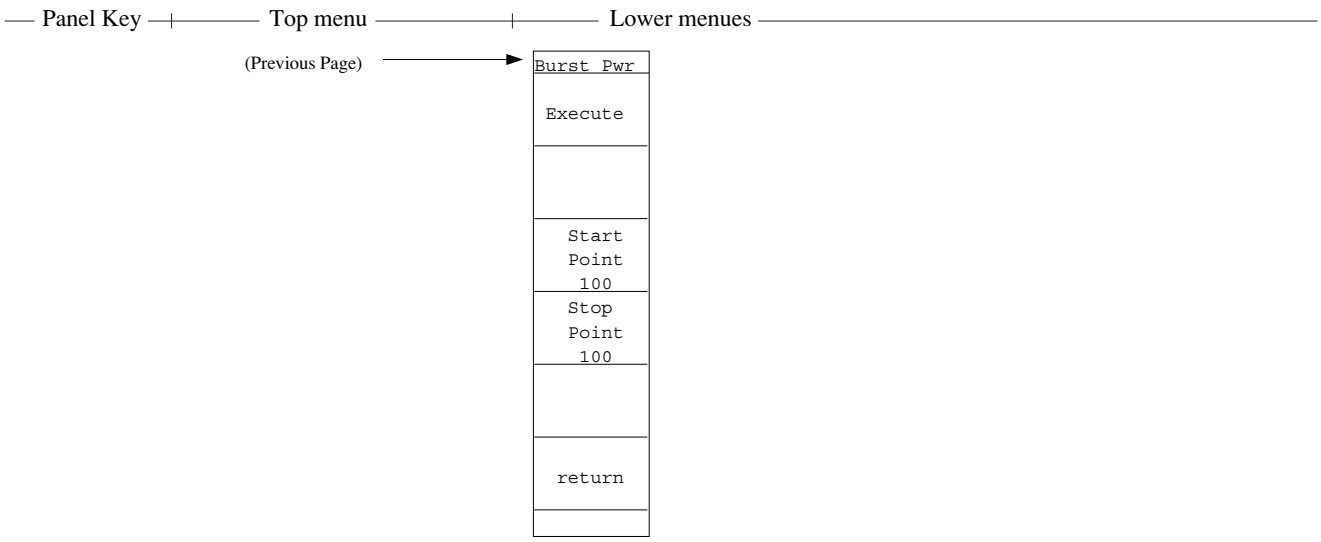
Menu Tree (10/28)



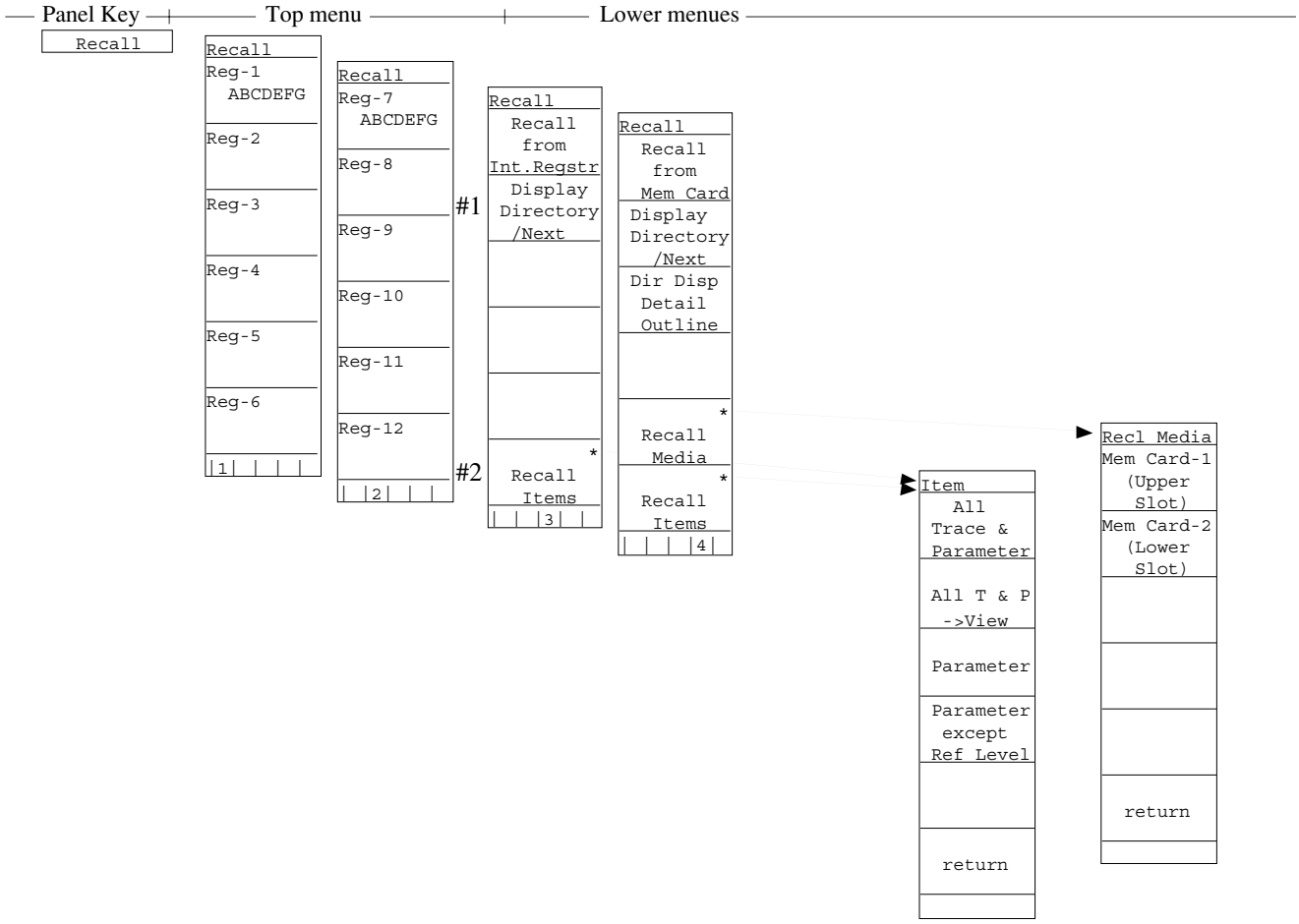
#8 Time Template: Set Standard Line of the time domain and judge Good/NG in relation to the standard line. Select Template Table, Template Movement, Measurement Mode, Template Table Preparation, Load/Save of Mask Table, etc..

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

Menu Tree (11/28)



Menu Tree (12/28)

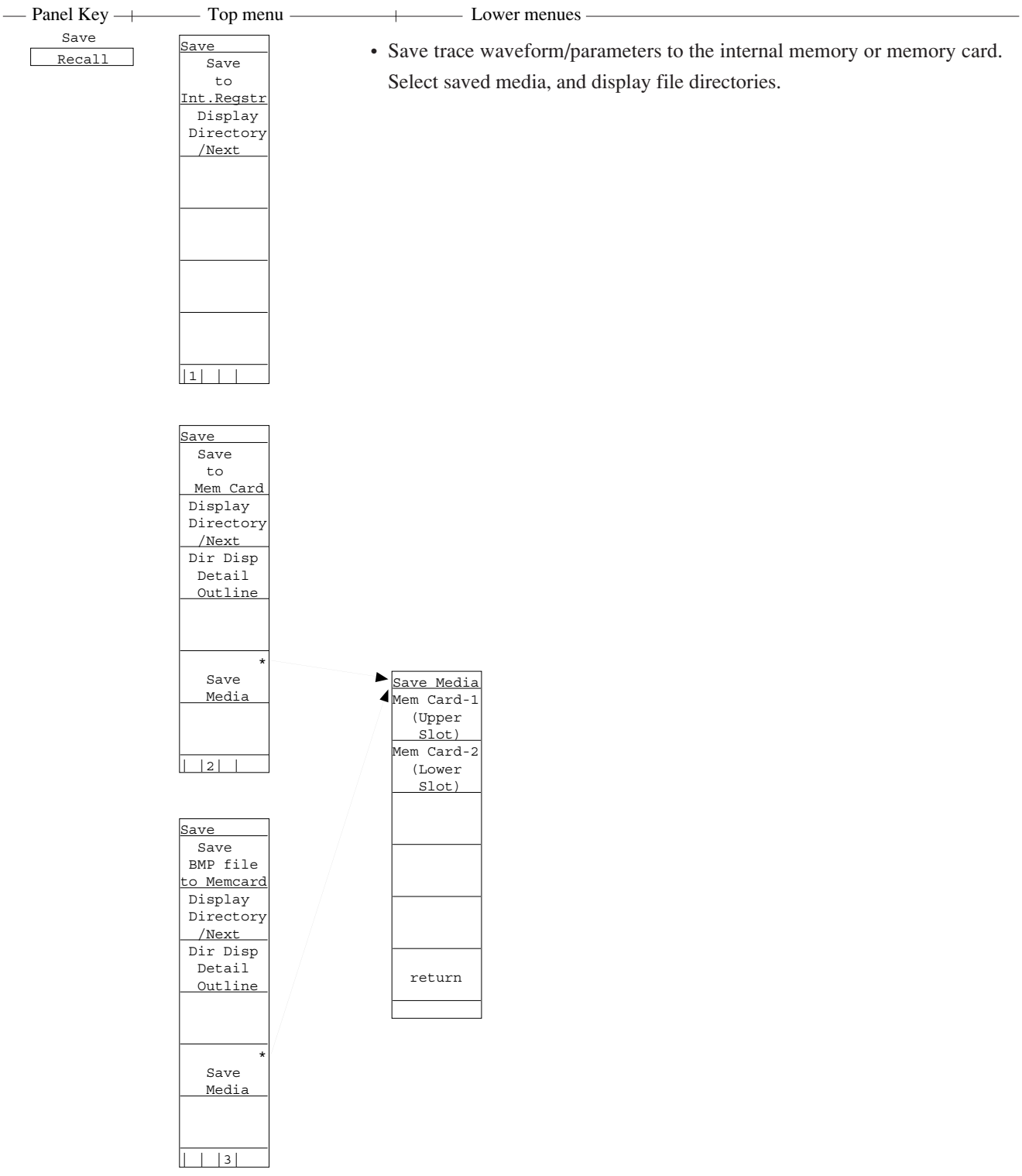


- Read out trace waveform/parameters from the internal memory or memory card.
  Select recall addresses and media/items, and display file directories.

  #1 Displays list of internal-memory directories.

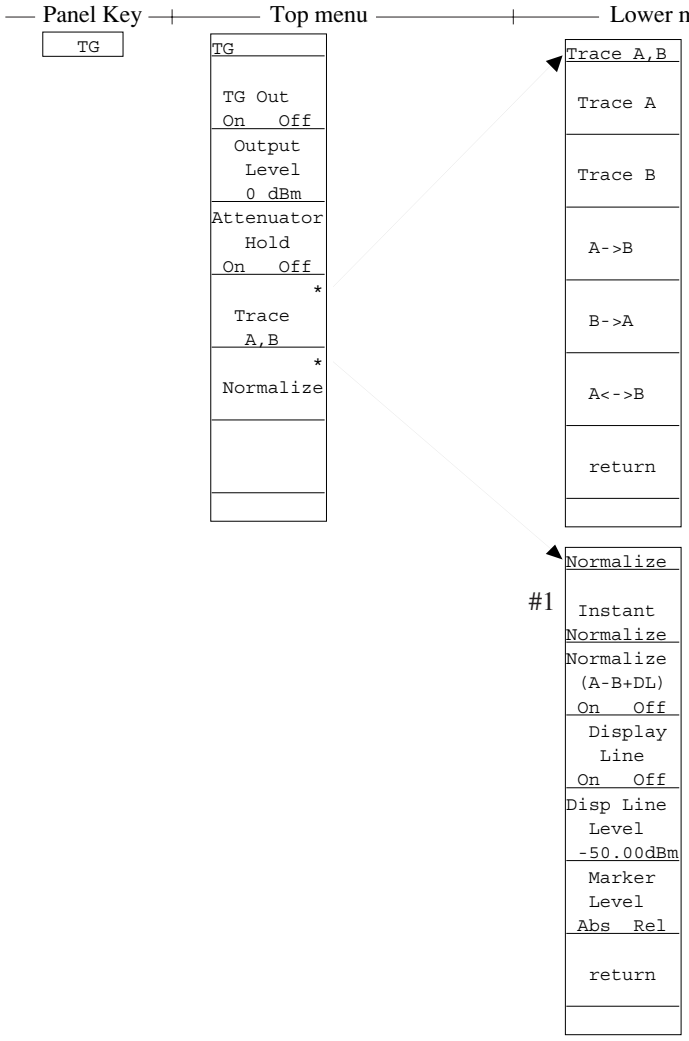
  #2 Specifies items to be recalled
  (trace waveform, parameter, etc.).

Menu Tree (13/28)



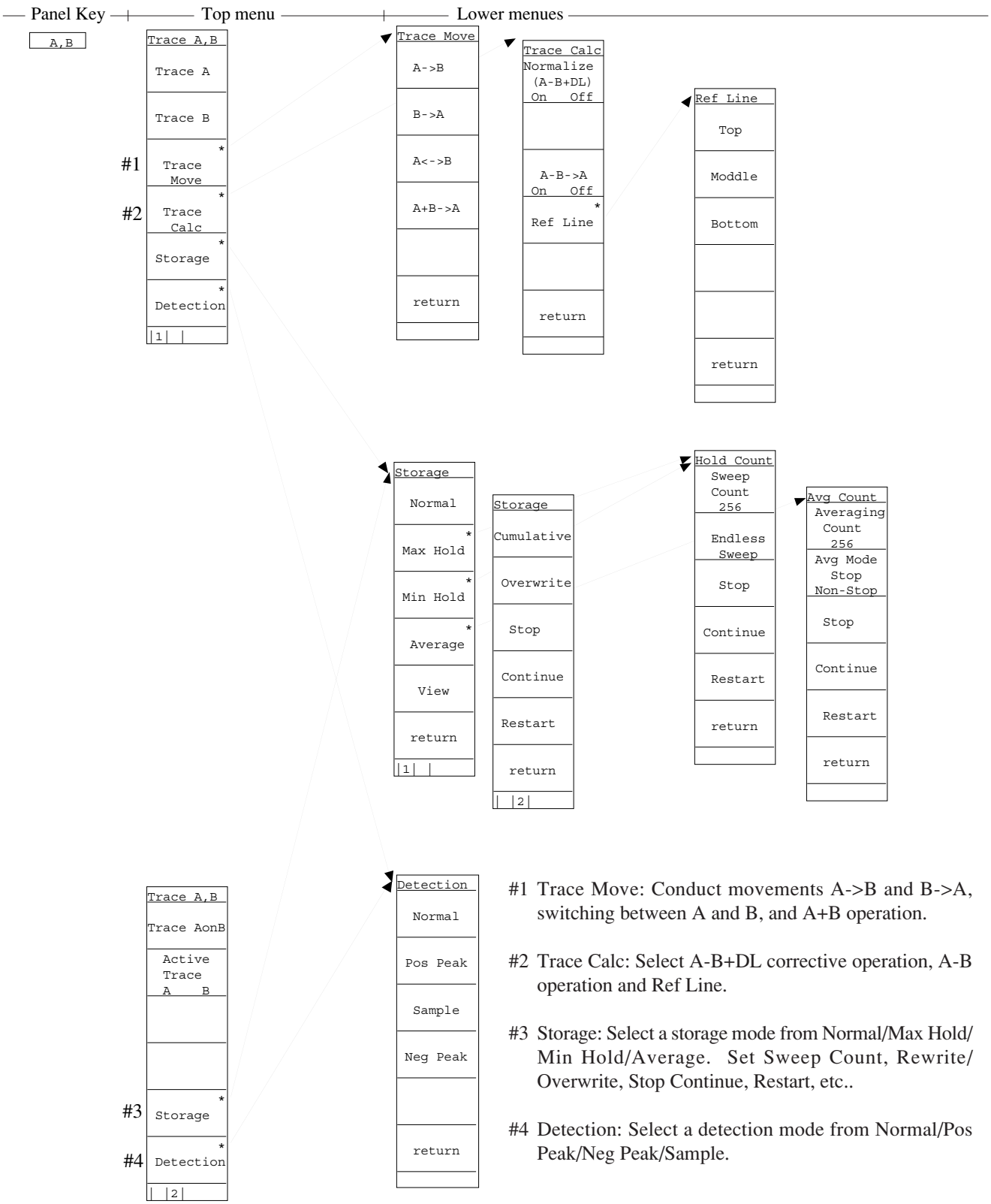
- Save trace waveform/parameters to the internal memory or memory card. Select saved media, and display file directories.

Menu Tree (14/28)



- Set ON/OFF and output level of tracking generator.
  #1 Normalize trace-A waveform data, and display it.

Menu Tree (15/28)



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

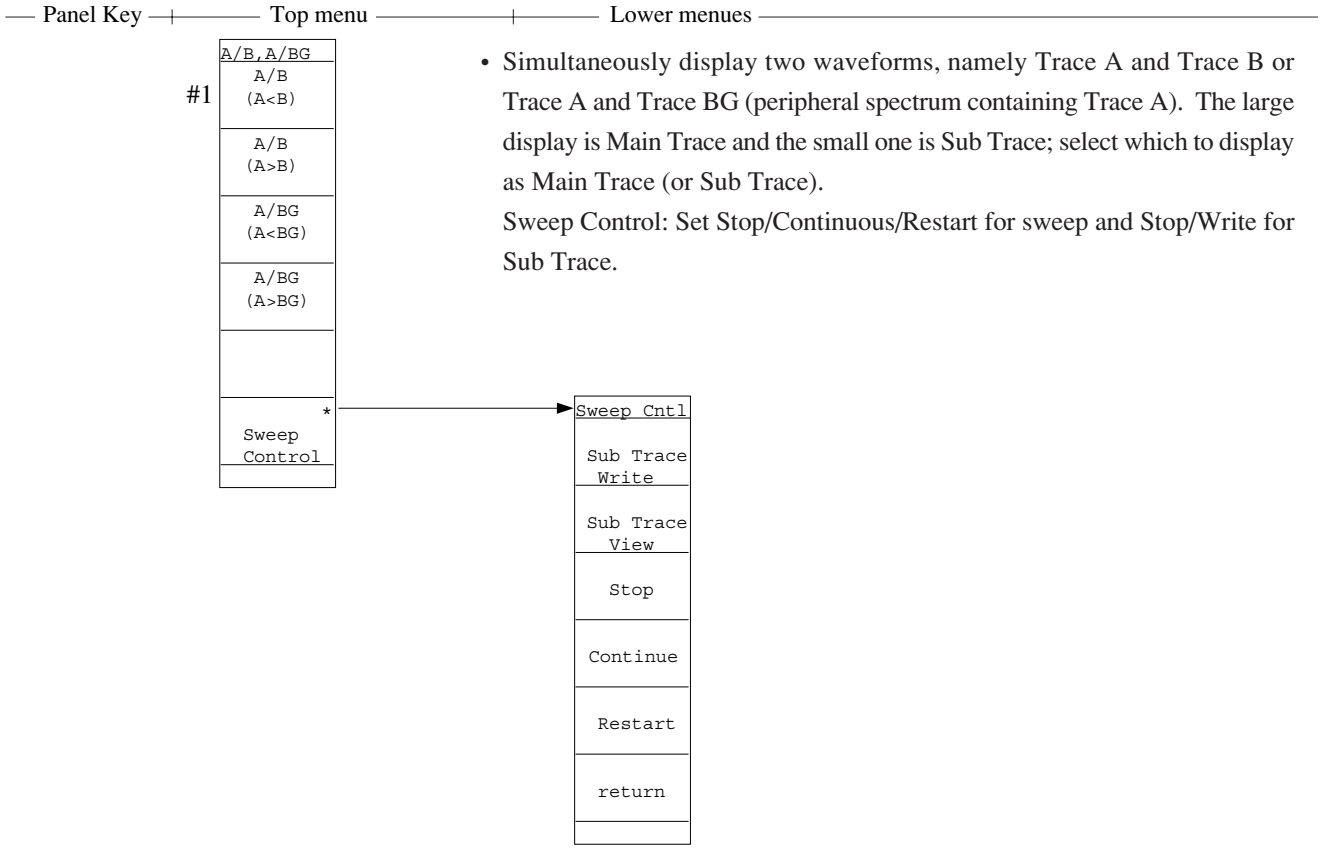
#2 Trace Calc: Select A-B+DL corrective operation, A-B operation and Ref Line.

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

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

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

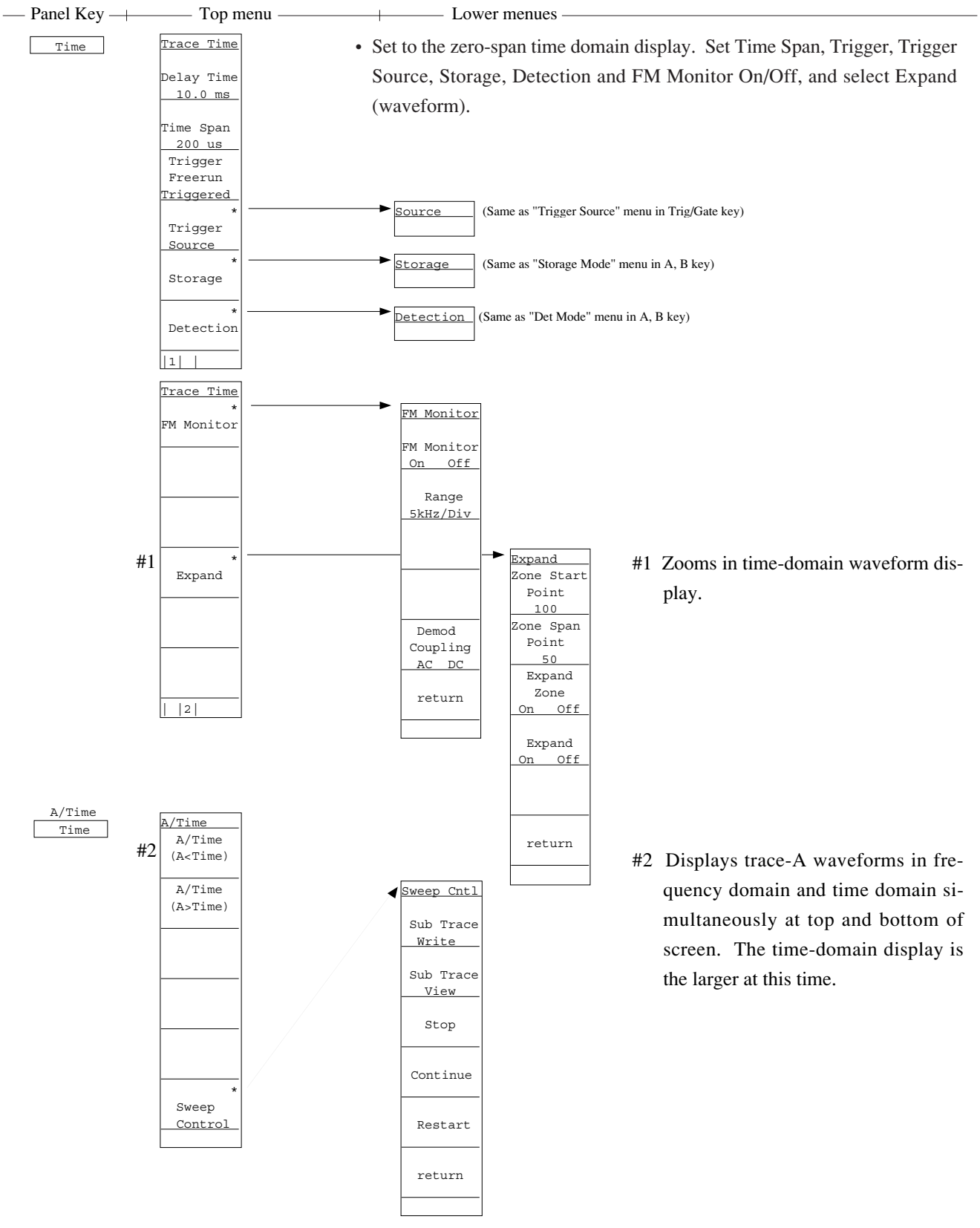
Menu Tree (16/28)



- 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)



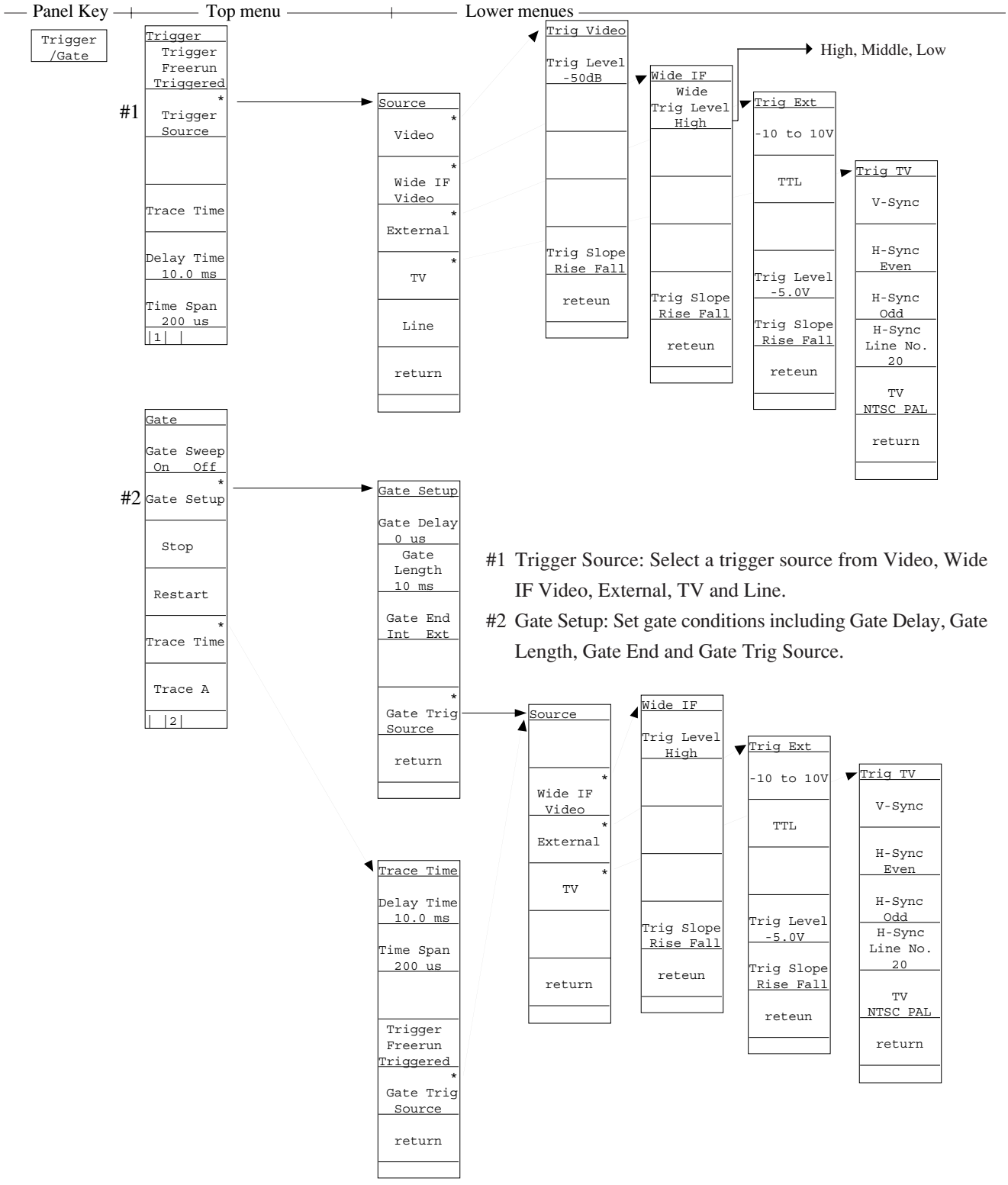
- Set to the zero-span time domain display. Set Time Span, Trigger, Trigger Source, Storage, Detection and FM Monitor On/Off, and select Expand (waveform).

#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)



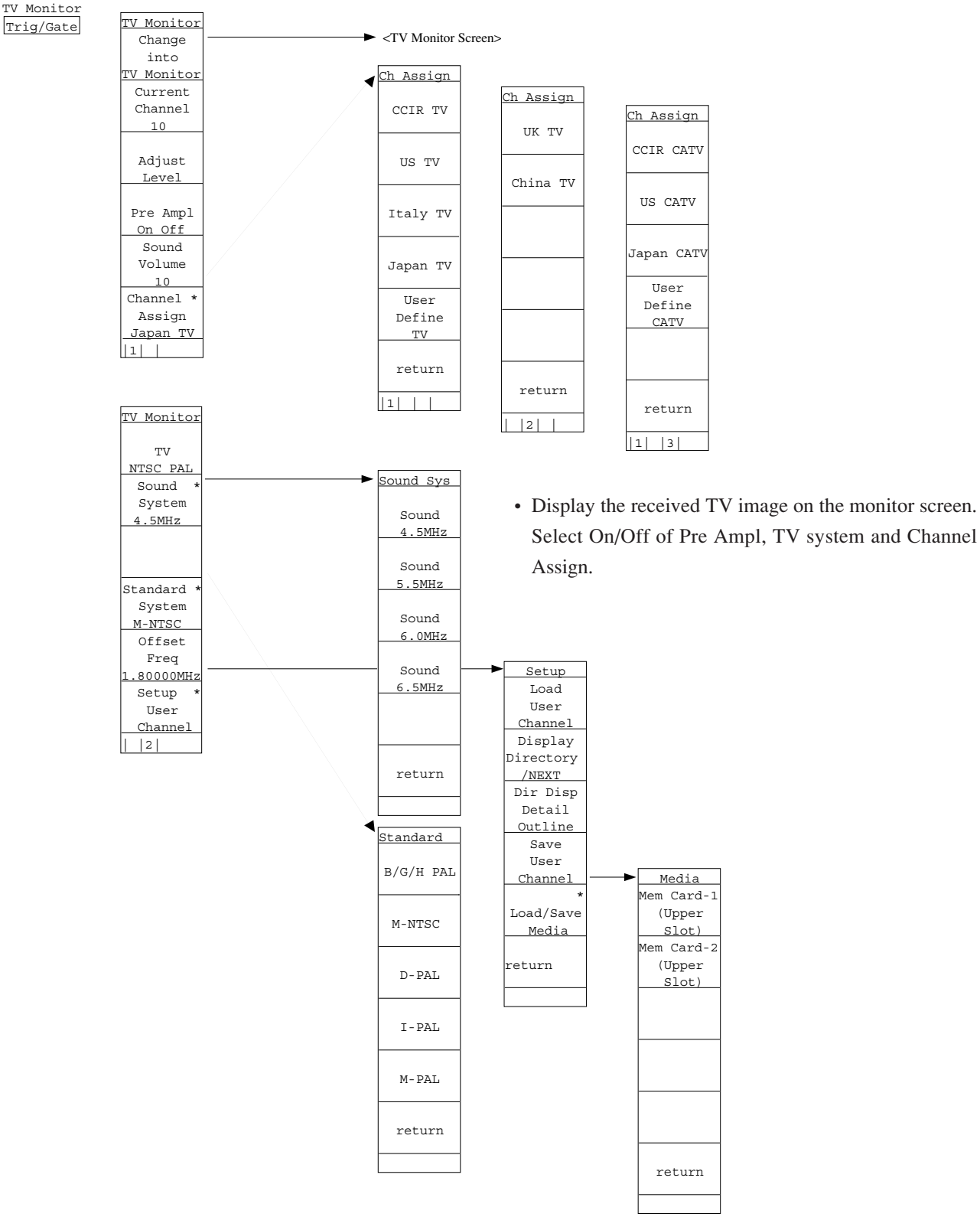
#1 Trigger Source: Select a trigger source from Video, Wide IF Video, External, TV and Line.

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

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

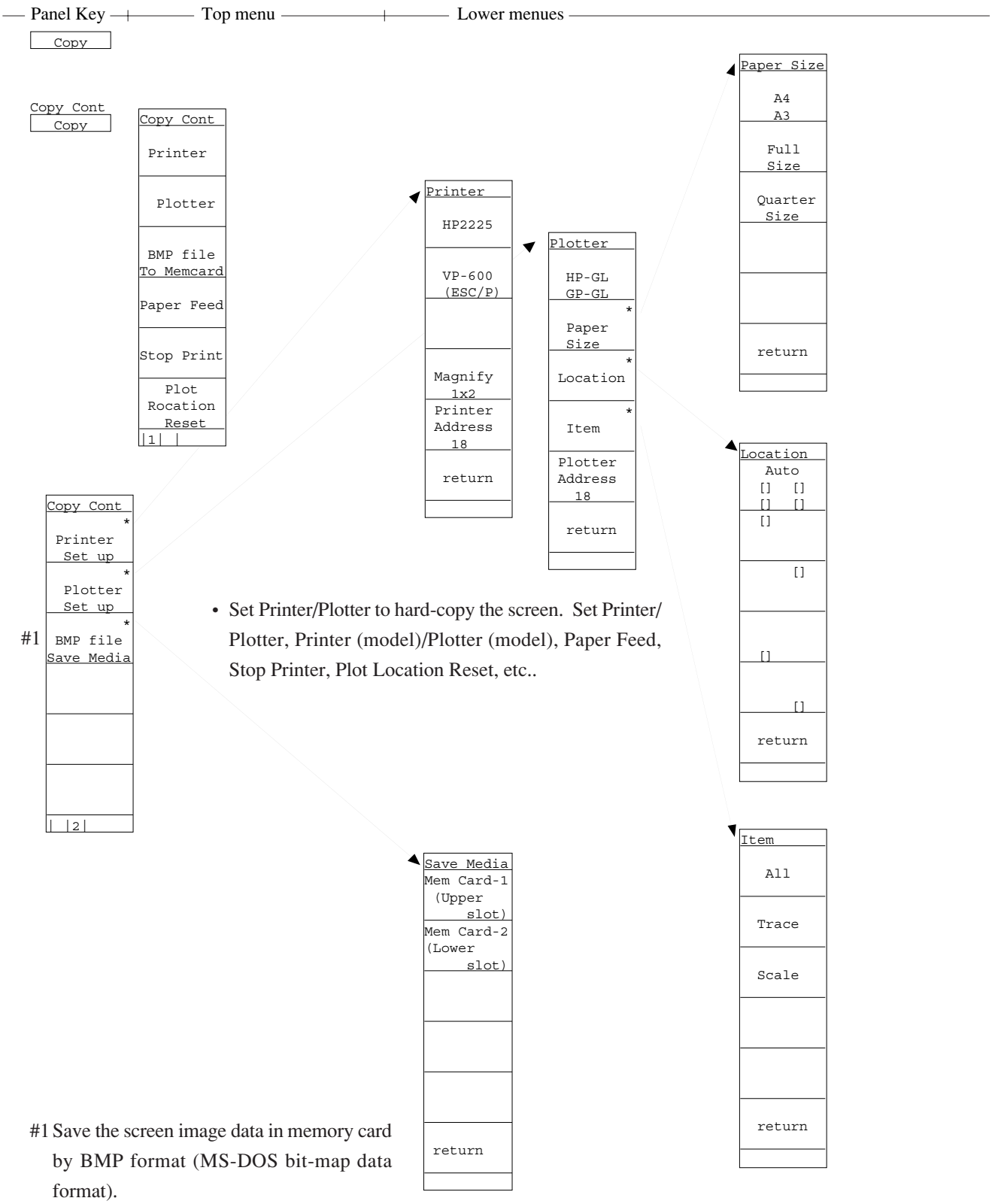
Menu Tree (19/28)

Panel Key — Top menu — Lower menues



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

Menu Tree (20/28)

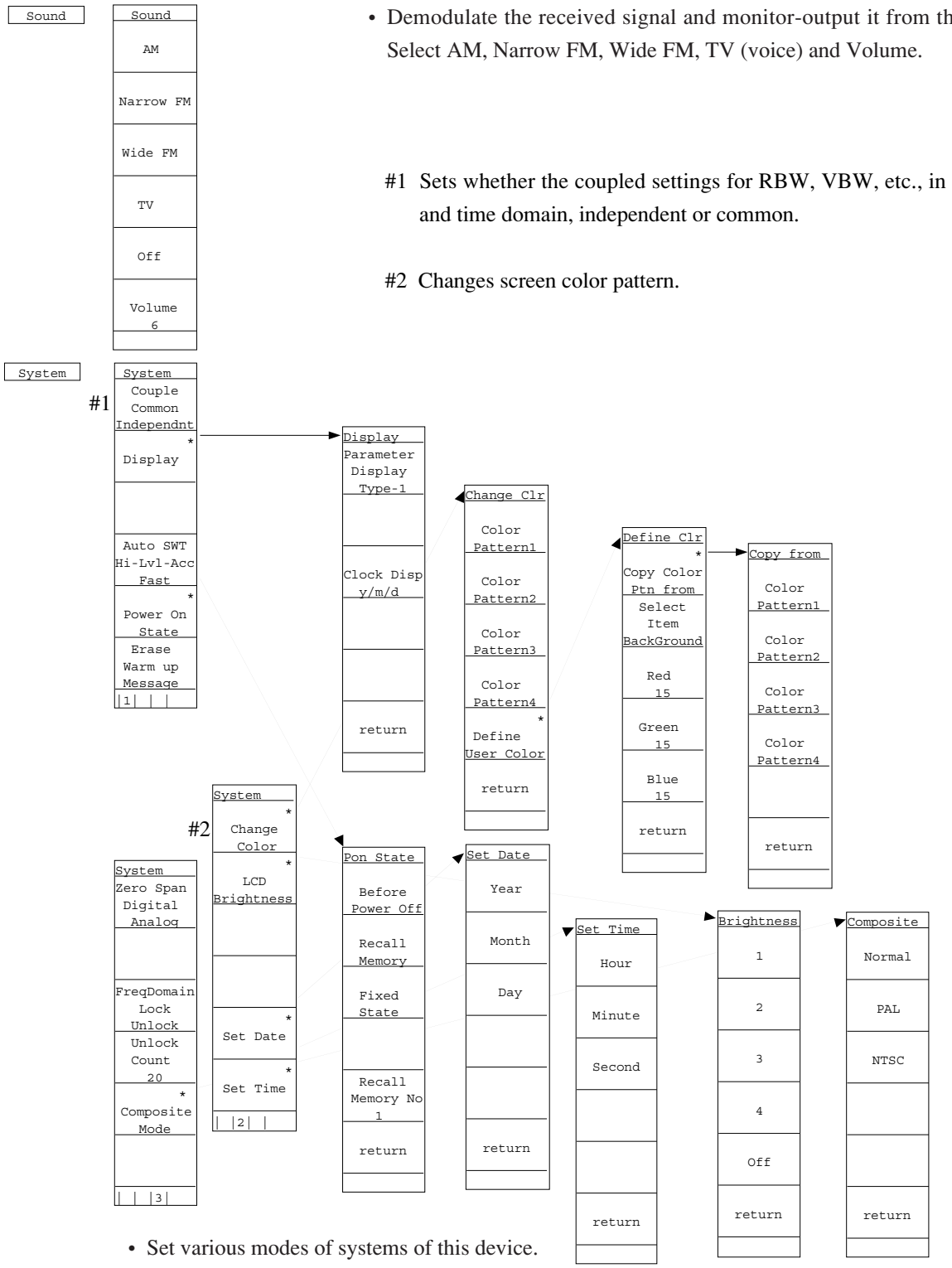


- Set Printer/Plotter to hard-copy the screen. Set Printer/Plotter, Printer (model)/Plotter (model), Paper Feed, Stop Printer, Plot Location Reset, etc..

#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.

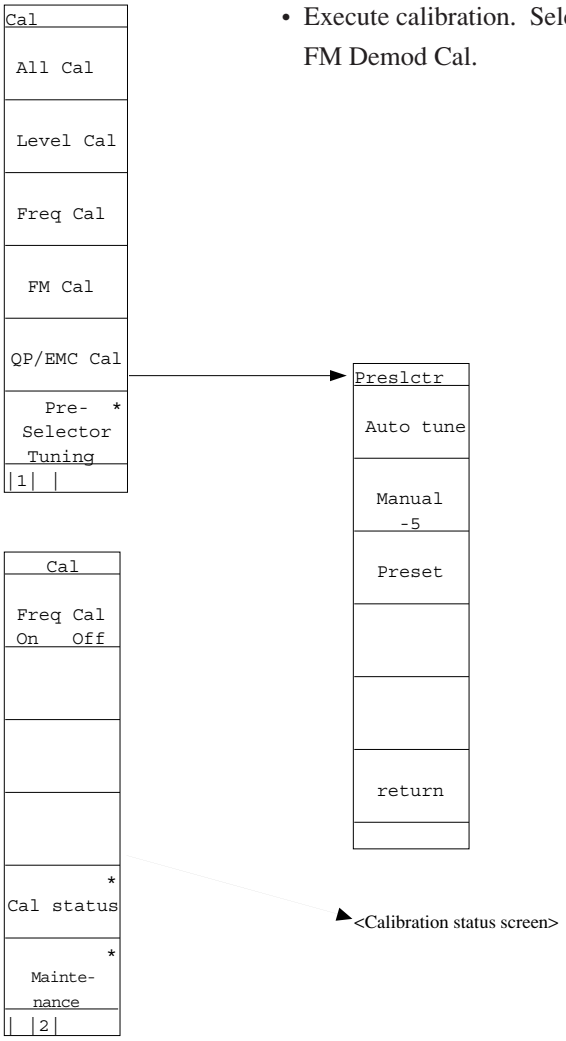
#2 Changes screen color pattern.

- 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

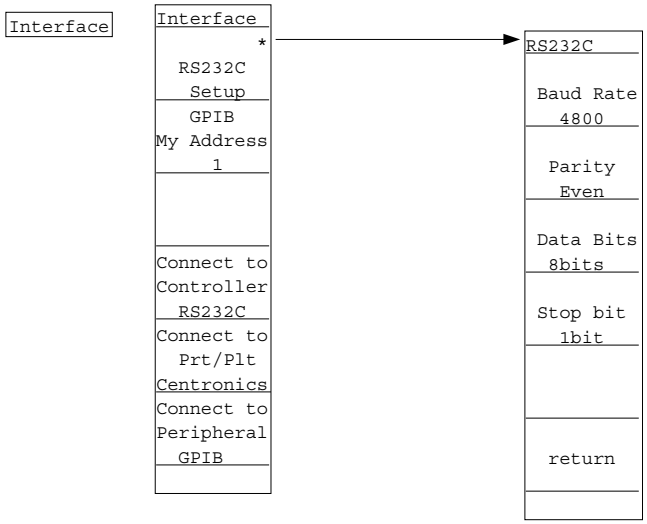


- Execute calibration. Select an item from All Cal, Level Cal, Freq Cal, and FM Demod Cal.

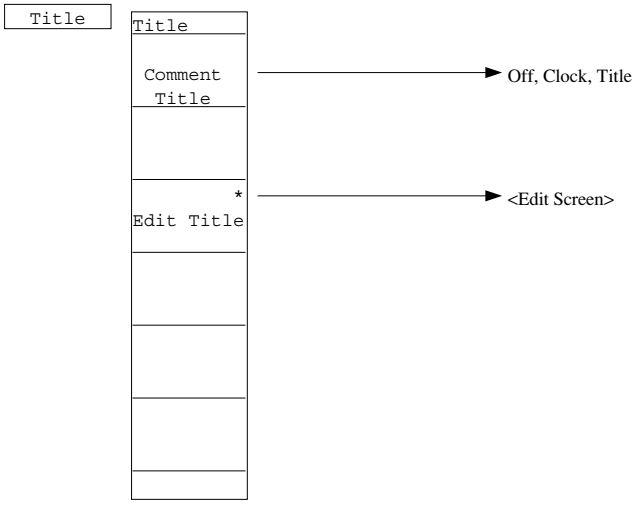
Menu Tree (23/28)

Panel Key — Top menu — Lower menues

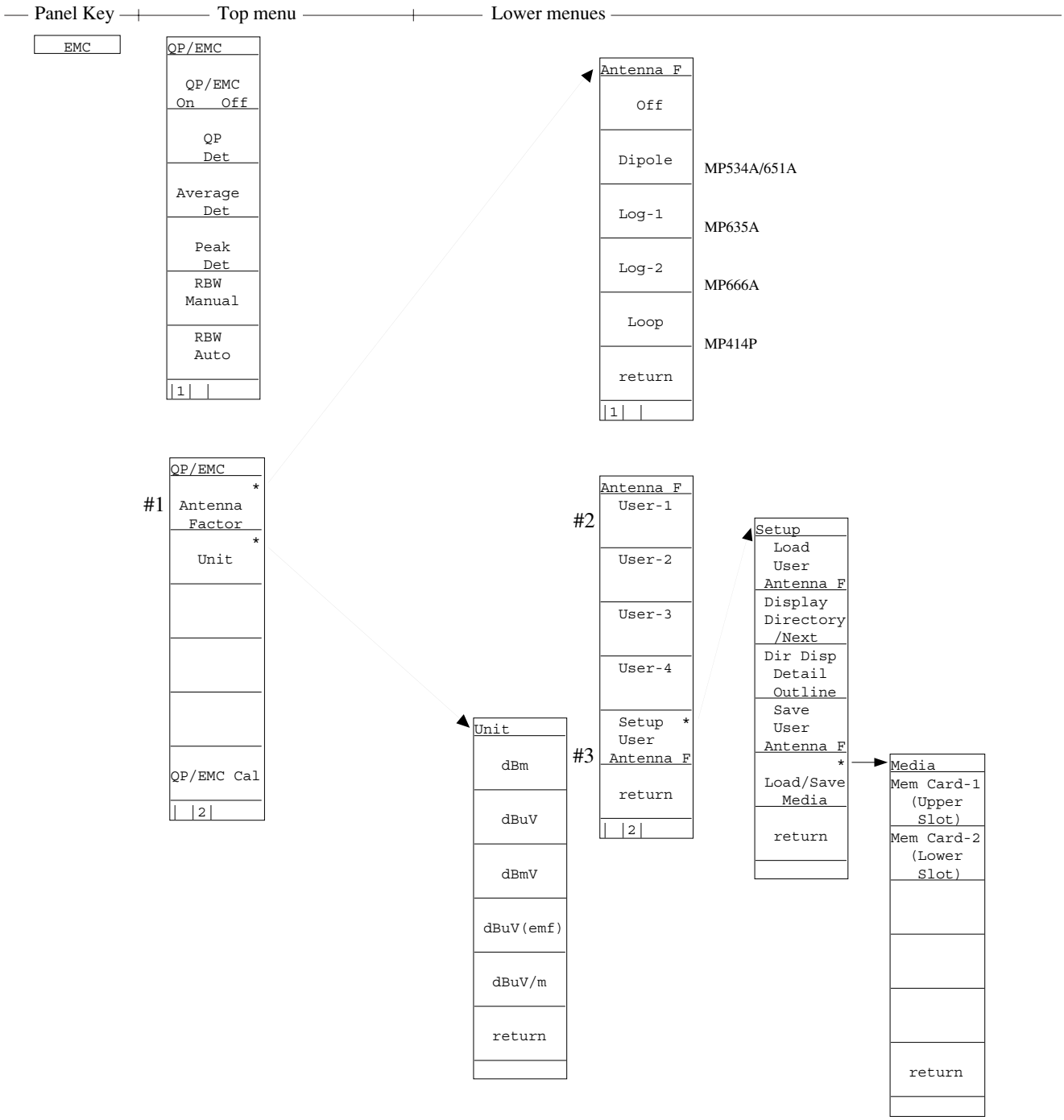
- Set interfaces for external devices to connect. Select RS232C, Centronics or GPIB, and set the RS232C interface, GPIB address, etc..



- Input a title to display on the screen.

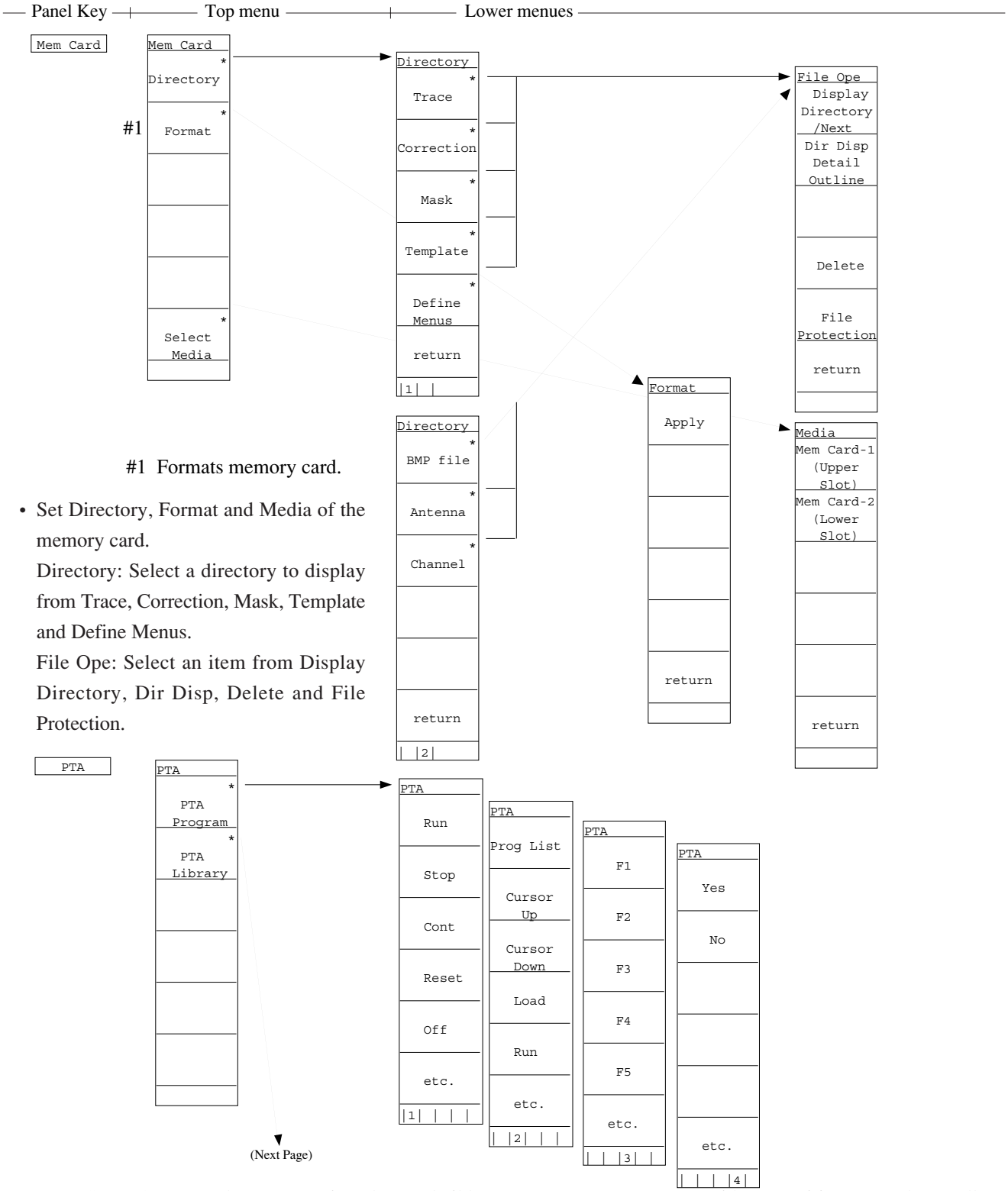


Menu Tree (24/28)



- 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)

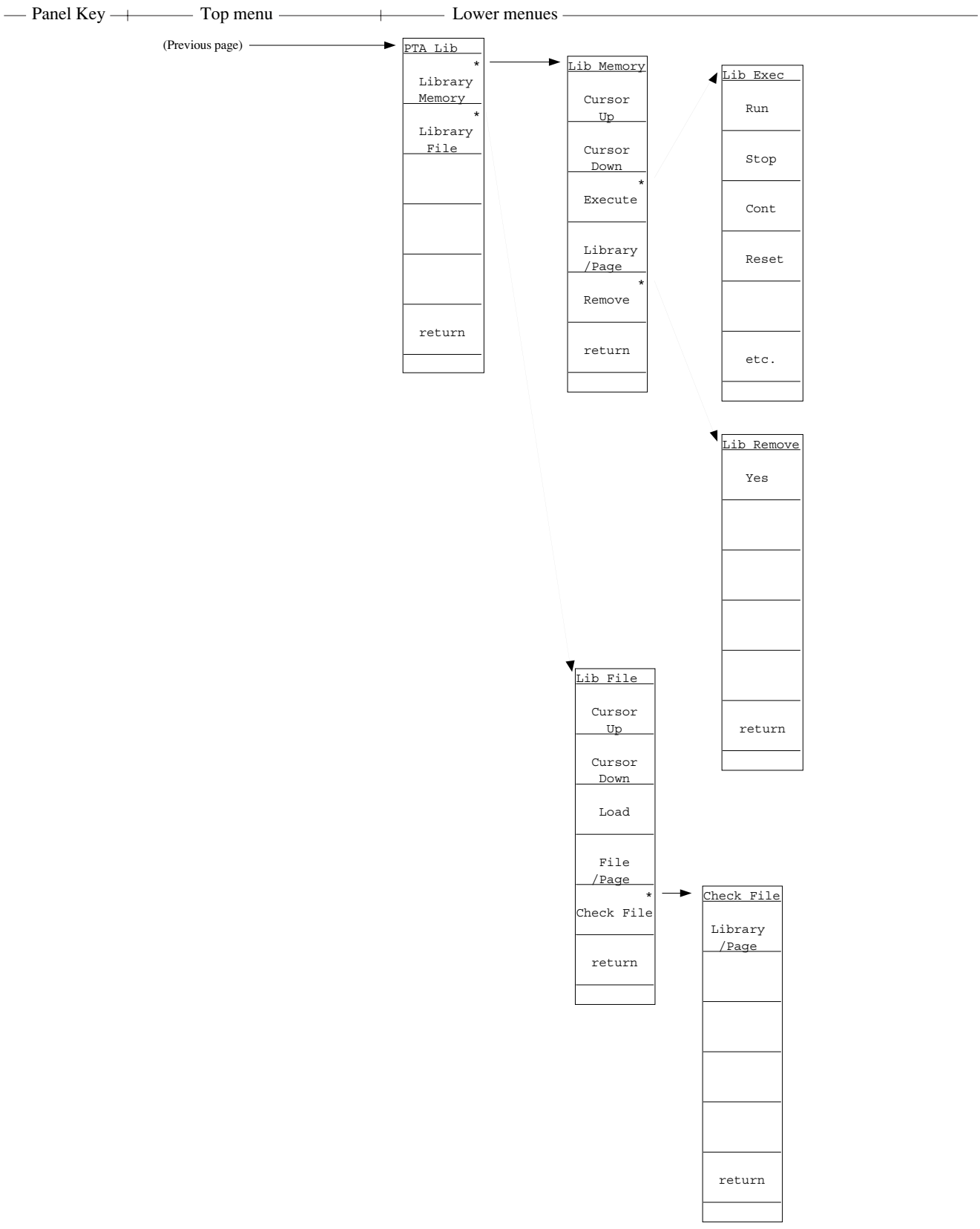


#1 Formats memory card.

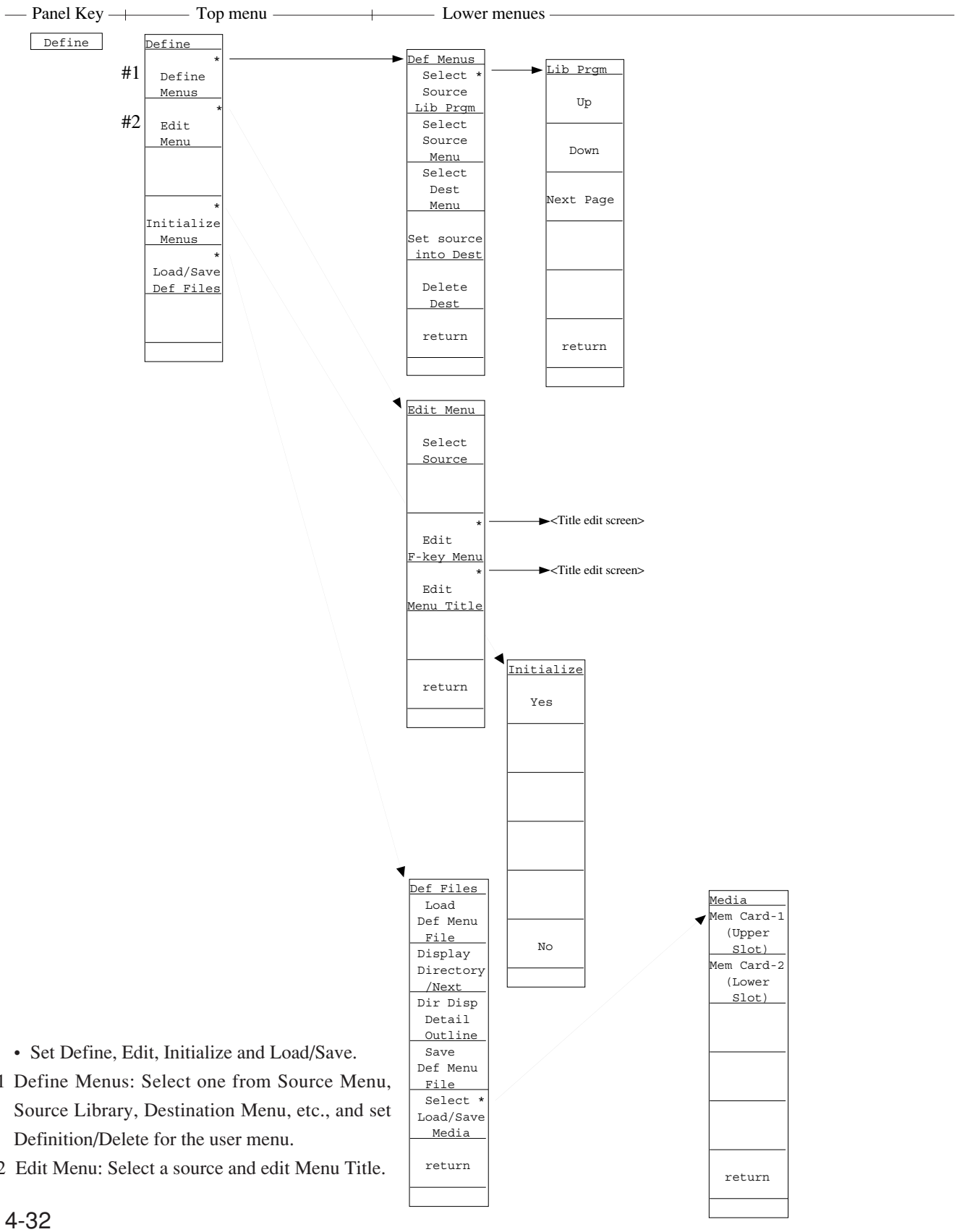
- Set Directory, Format and Media of the memory card.
  Directory: Select a directory to display from Trace, Correction, Mask, Template and Define Menus.
  File Ope: Select an item from Display Directory, Dir Disp, Delete and File Protection.

- 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 Freq/Time.
	Preset All	
	Preset Sweep controll	
	Preset Trace Parameters	
	Preset Level Parameters	
	Preset Freq/Time Parameters	
Hold		
Local		

SECTION 5
BASIC OPERATION PROCEDURE

TABLE OF CONTENTS

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.

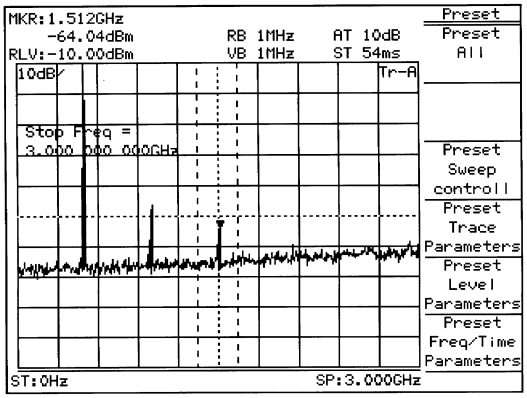


Fig. 5-1

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 [CAL / 0] key.

Select All Cal from the menu displayed on the display.

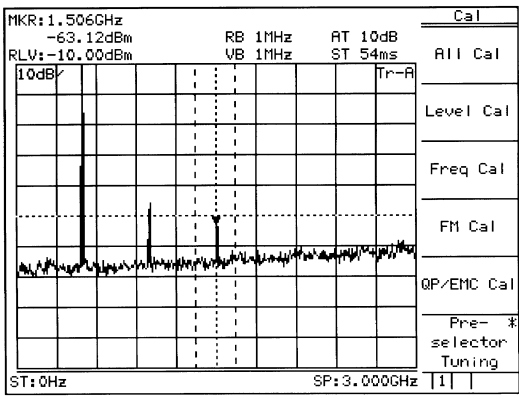


Fig. 5-2

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.

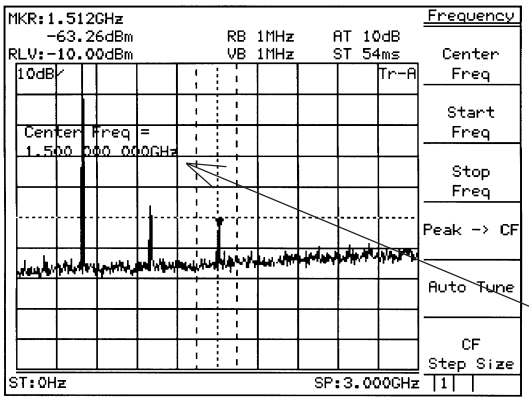


Fig. 5-3

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

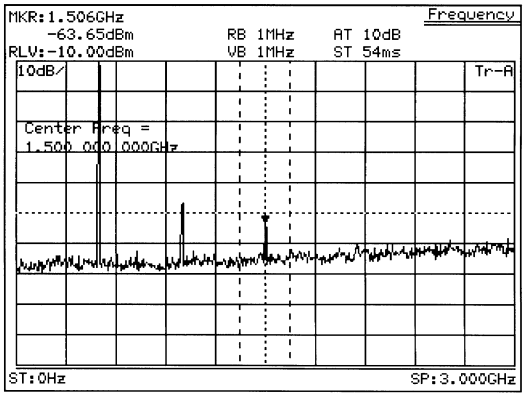


Fig. 5-4

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.

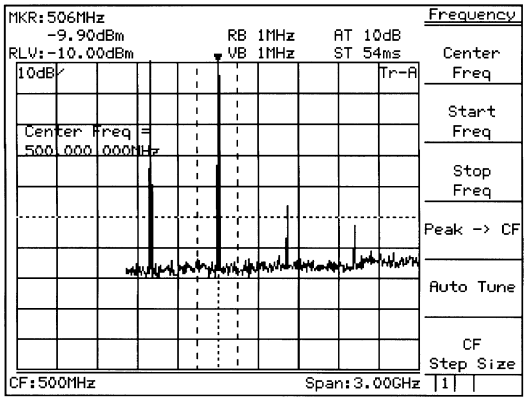


Fig. 5-5

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.

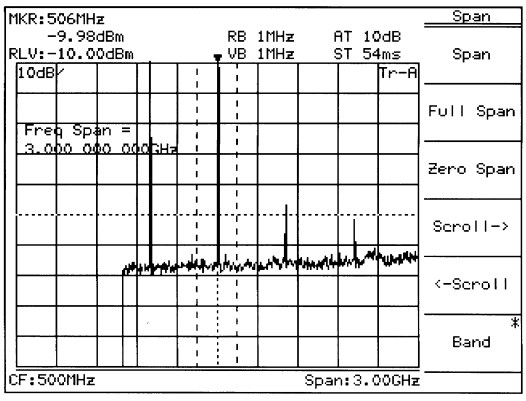


Fig. 5-6

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.

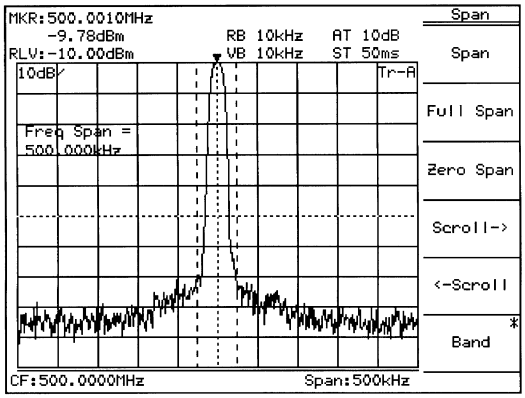


Fig. 5-7

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.

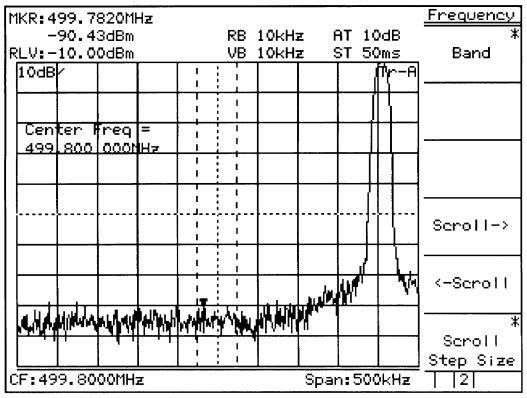


Fig. 5-8

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 [Peak Search] key.

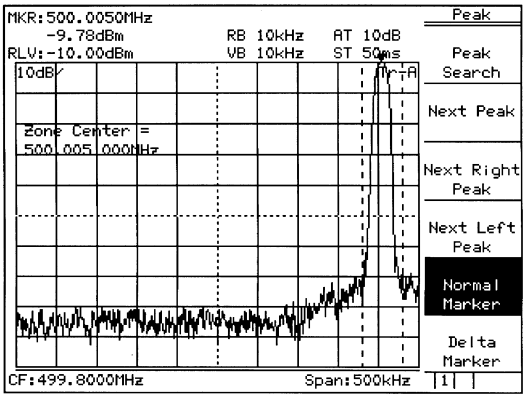


Fig. 5-9

*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 [More] to open 2nd page, and press Marker → key.

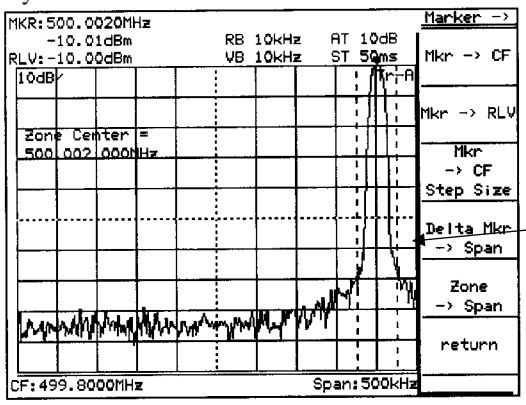


Fig. 5-10

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.

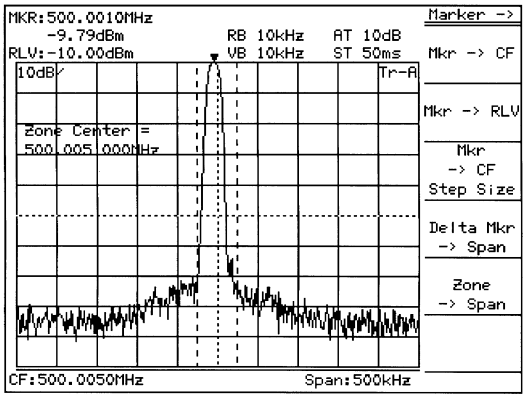


Fig. 5-11

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

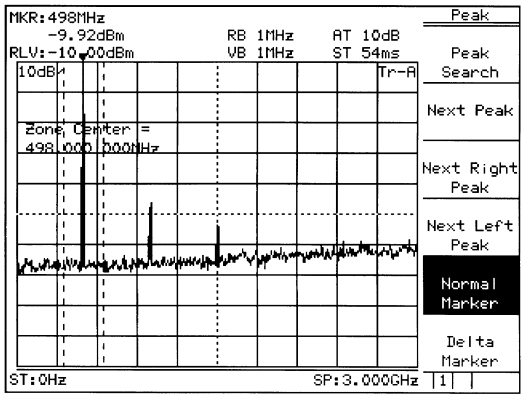


Fig. 5-12

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.

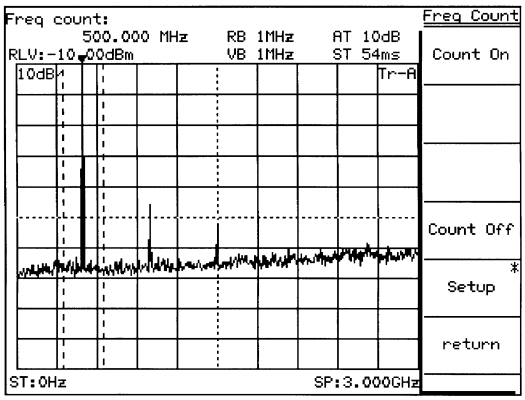


Fig. 5-13

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 point 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.

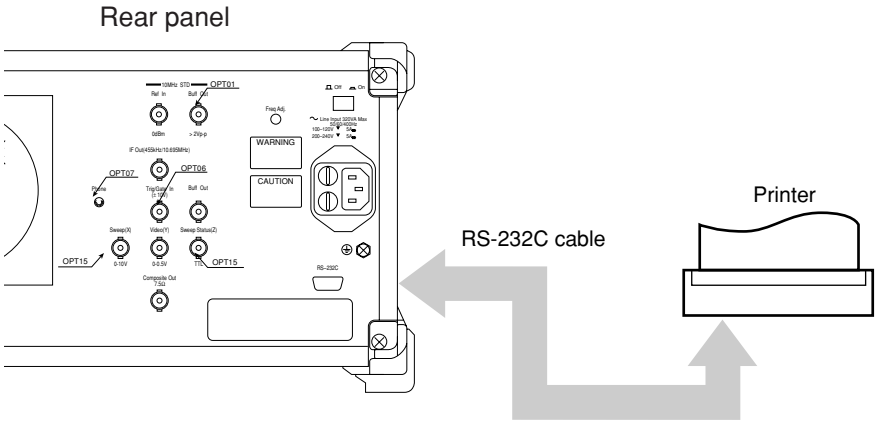


Fig. 5-14

Initialization (Restore shipment state)

This section describes how to initialize a parameter and waveform data that is not initialized by Preset key, like a correction factor, a standard line, a PTA program, Config information, etc.

1) Turn the power on, pressing the Preset key. Please continue pressing the Preset key until beep sounds. Beep sounds about 5 seconds later, after turning on the power switch.

SECTION 6
PERFORMANCE TESTS

In this section, measuring instruments, setup and operations necessary for conducting performance tests of MS2650/2660B/C 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 MS2651B/MS2653B and MS2661B/2663B/2661C/2663C.

Also note that with regard to performance tests of Resolution bandwidth accuracy, Resolution bandwidth selectivity, and Resolution bandwidth switching uncertainty, the standard of measured objects differ between MS2651B/2661B/2653B/2663B and MS2661C/MS2663C.

TABLE OF CONTENTS

SECTION 6 PERFORMANCE TESTS

Requirement for Performance Tests

Performance tests are used as preventive maintenance to prevent degradation of the MS2650/MS2660B/C series performance before it occurs.
Use the performance tests whenever necessary such as at acceptance and periodic inspection of the MS2650/MS2660B/C series and to verify performance after repair. Execute the performance tests listed below to verify the MS2650/MS2660B/C series performance at acceptance inspection, periodic inspection and after repair.

- Reference oscillator frequency stability
- Frequency readout accuracy
- Frequency span readout accuracy
- Resolution bandwidth and selectivity
- Sideband phase noise
- Frequency measurement accuracy
- Amplitude display linearity
- Frequency response
- Reference level accuracy
- Average noise level
- Second harmonic distortion
- Resolution bandwidth (RBW) switching uncertainty
- Input attenuator switching uncertainty
- 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 (69269A with Option 2B)	• 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 8.1 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	
50Ω terminator (MP752A)	• Frequency range DC to 8.1 GHz • VSWR ≤1.2	Average noise level
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 $\leq 1 \times 10^{-9}$/day	Reference-oscillator frequency stability Frequency readout accuracy Frequency measurement accuracy

† 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/MS2660B/C 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)

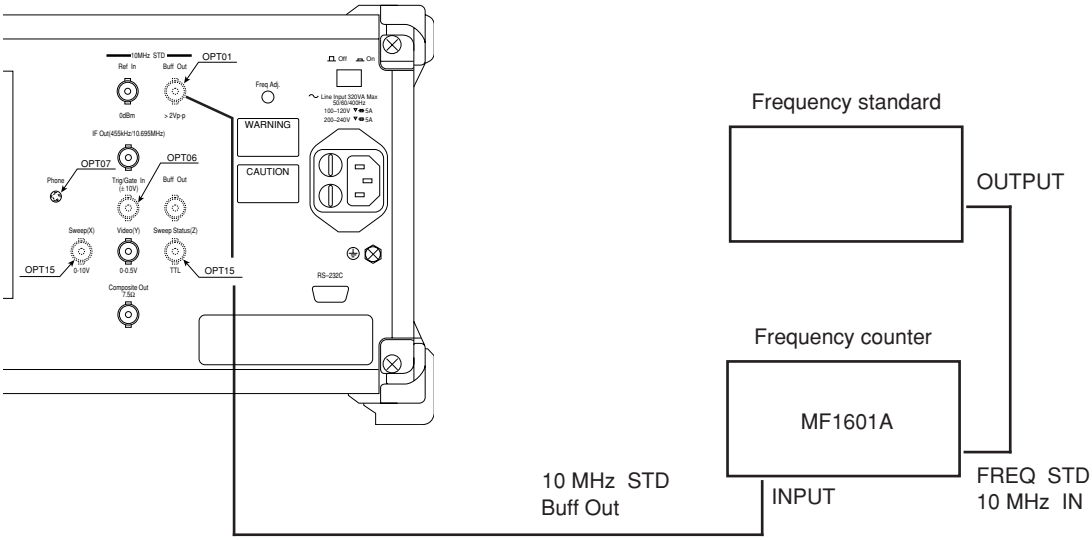
■ Reference oscillator

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

(2) Test instruments

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

(3) Setup



Reference Oscillator Frequency Stability Test

(4) Procedure

Aging rate/day: Test this at the ambient temperature ±2 °C 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. $$\text{Temperature stability} = \frac{(\text{counter reading at 50 °C}) - (\text{counter reading at 25 °C})}{(\text{counter reading at 25 °C})}$$
7	Change the chamber temperature to 0 °C and repeat steps 5 and 6.

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 frequency standard.

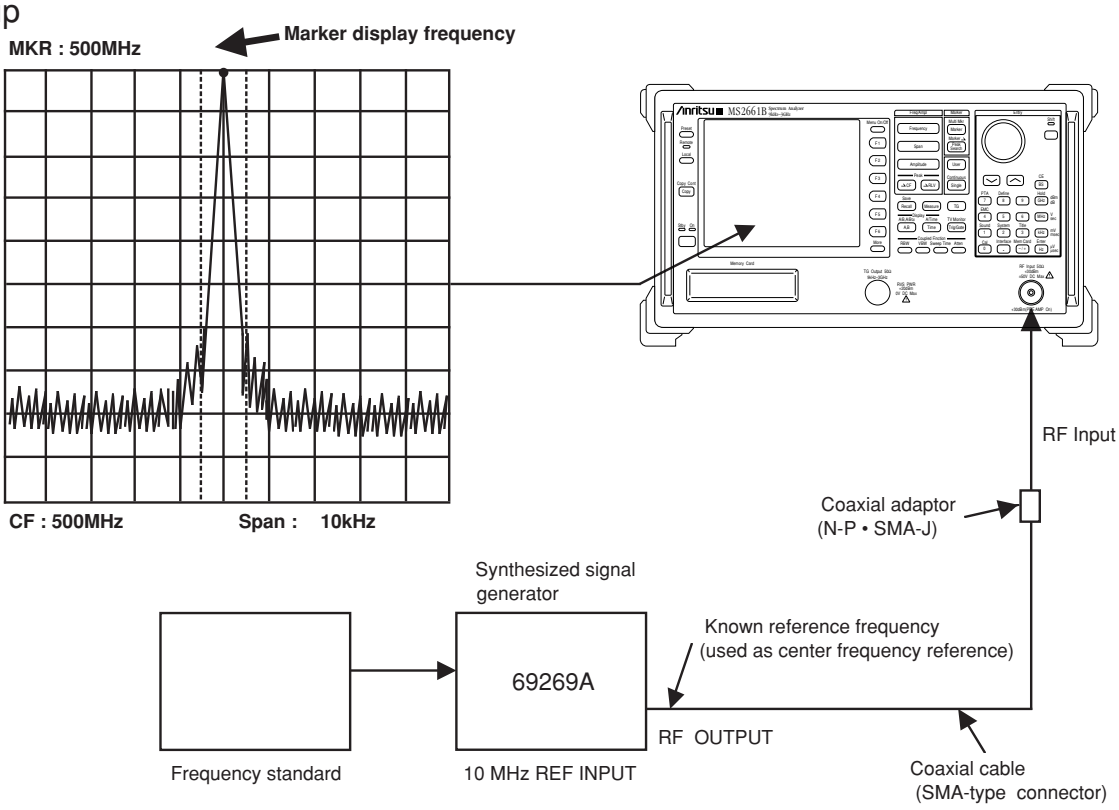
(1) Specifications

- Frequency readout accuracy: ± (Readout frequency × reference frequency accuracy + span × span accuracy + 100 Hz) ; * Span ≥10 kHz (after calibration)

(2) Test instruments

- Synthesized signal generator: 69269A
- Frequency standard

(3) Setup



Center-Frequency Readout-Accuracy Test

(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.

Frequency readout accuracy test

• MS2651B/2661B/2661C

Signal generator	Center frequency	Span frequency	Center frequency		
			Minimum value	Maker value	Maximum value
500 MHz	500 MHz	10 kHz	499.999 66 MHz		500.000 34 MHz
		200 kHz	499.995 2 MHz		500.004 8 MHz
		100 MHz	497.6 MHz		502.4 MHz

• MS2653B/2663B/2663C

Signal generator	Center frequency	Span frequency	Band	Center frequency		
				Minimum value	Maker value	Maximum value
500 MHz	500 MHz	10 kHz	0	499.999 66 MHz		500.000 34 MHz
		200 kHz		499.995 2 MHz		500.004 8 MHz
		100 MHz		497.6 MHz		502.4 MHz
5 GHz	5 GHz	10 kHz	1^-	4.999 999 55 GHz		5.000 000 45 GHz
		200 kHz		4.999 994 8 GHz		5.000 005 2 GHz
		100 MHz		4.997 6 GHz		5.002 4 GHz
7.5 GHz	7.5 GHz	10 kHz	1^+	7.499 999 50 GHz		7.500 000 50 GHz
		200 kHz		7.499 994 8 GHz		7.500 005 2 GHz
		100 MHz		7.497 6 GHz		7.502 4 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.

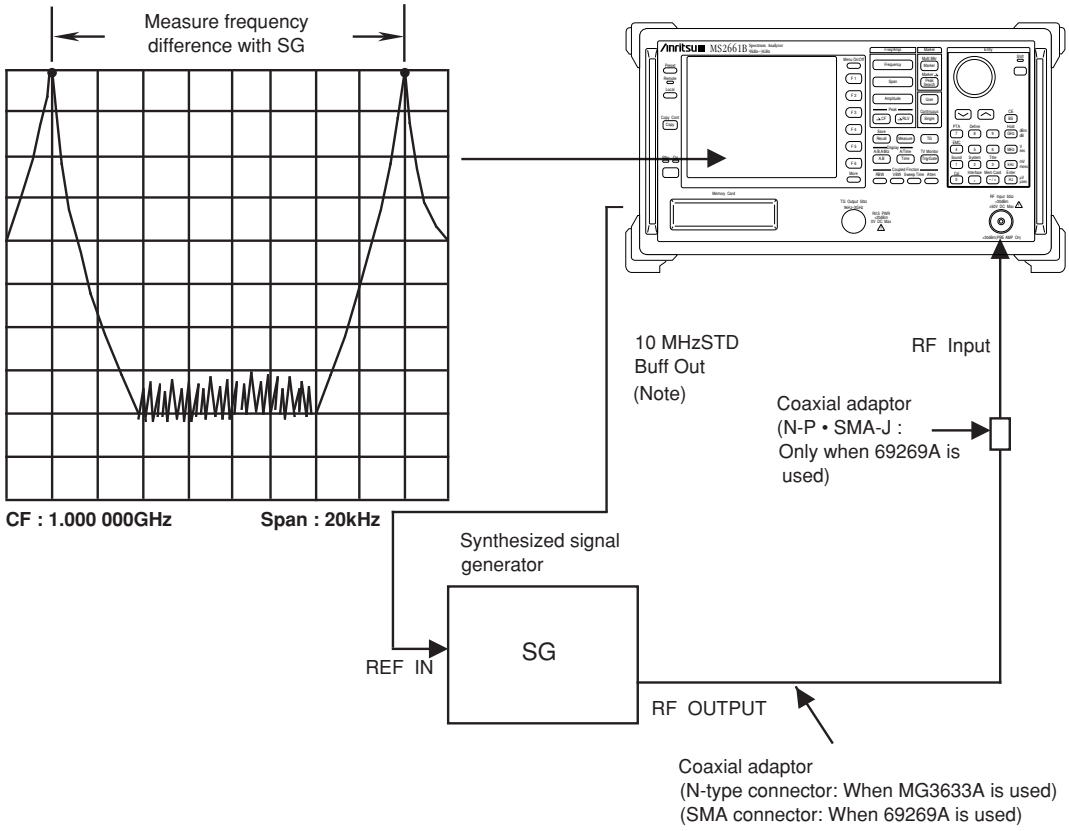
(1) Specifications

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

(2) Test instrument

- Synthesized signal generator: MG3633A
  69269A

(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. -10 to -20 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

MS2651B/2661B/2661C		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

MS2653B/2663B/2663C		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
4.05 GHz	100 MHz	4.01 GHz	4.09 GHz	97.5 MHz		102.5 MHz
	1 GHz	3.65 GHz	4.45 GHz	0.975 GHz		1.025 GHz
	8.1 GHz	0.81 GHz	7.29 GHz	7.8975 GHz		8.3025 GHz

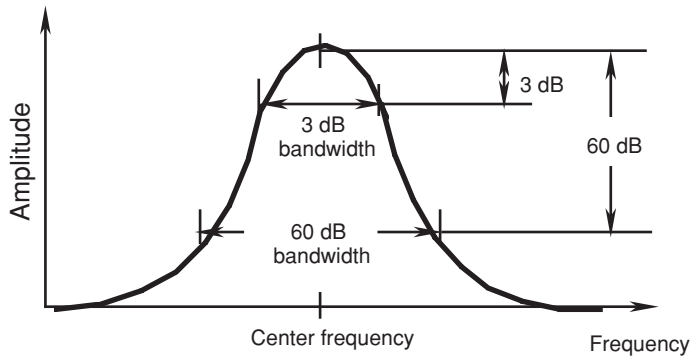
Resolution bandwidth (RBW) and selectivity

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 (3 dB bandwidth), then the 60 dB bandwidth and calculate the 60 dB/3 dB bandwidth ratio.

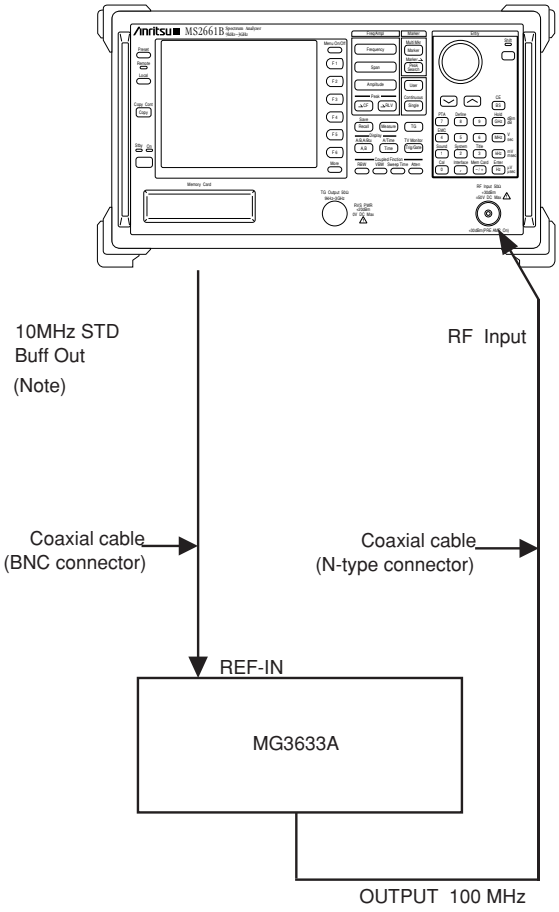
(1) Specifications

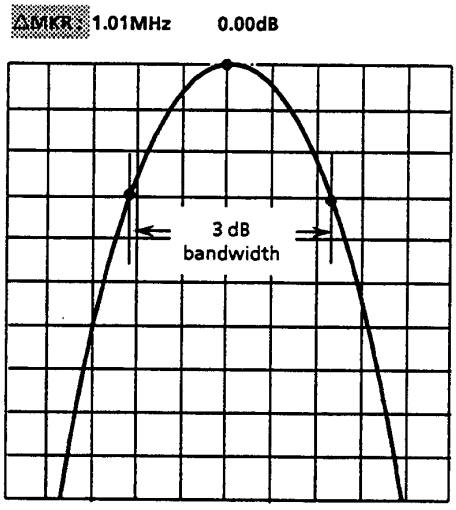
- Resolution bandwidth accuracy (MS2661C/2663C only):
  ±20 % (RBW=1 kHz to 1 MHz)
  ±30 % (RBW=3 MHz)
- Selectivity (60 dB/3 dB bandwidth):
  - MS2651B/2661B/2653B/2663B
    ≤15:1 (RBW=1 MHz, 3 MHz)
    ≤10:1 (RBW=1 kHz to 300 kHz)
  - MS2661C/2663C
    ≤15:1 (RBW=1 kHz to 3 MHz)

(2) Test instrument

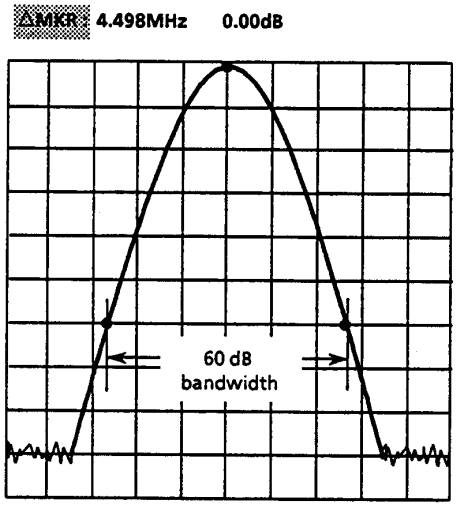
- Synthesized signal generator: MG3633A

(3) Setup





(a) Resolution bandwidth



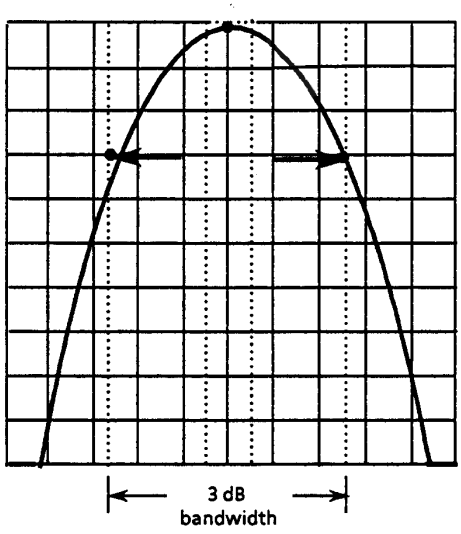
(b) 60 dB dropped bandwidth

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 ..... 5 MHz RBW (MANUAL) ..... 1 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 [Single] 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 X dB 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 1 MHz and the frequency span 5 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)

• MS2651B/2661B/2653B/2663B

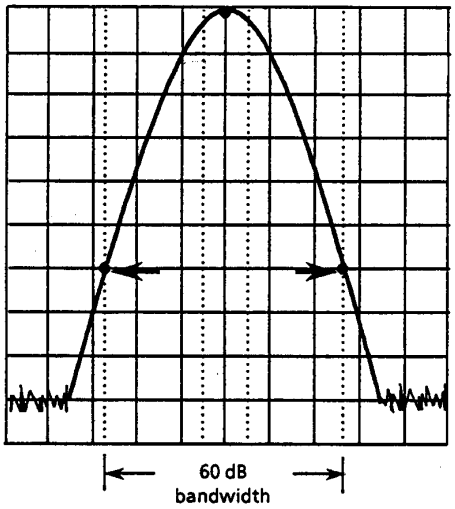
Resolution bandwidth	Frequency span	3 dB bandwidth
5 MHz	10 MHz	
1 MHz	5 MHz	
300 kHz	500 kHz	
100 kHz	200 kHz	
30 kHz	50 kHz	
10 kHz	20 kHz	
3 kHz	5 kHz	
1 kHz	2 kHz	

• MS2661C/2663C

Resolution bandwidth	Frequency span	3 dB bandwidth
3 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 ..... 20 MHz RBW (MANUAL) ..... 1 MHz Scale ..... LOG 10 dB/div VBW ..... 100 Hz Marker ..... NORMAL Zone Width ..... 1 div
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 X dB 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 1 MHz and the frequency span 20 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 ≤10.



60 dB Bandwidth Measurement

Selectivity Test (60 dB/3 dB Bandwidth Ratio)

• MS2651B/2661B/2653B/2663B

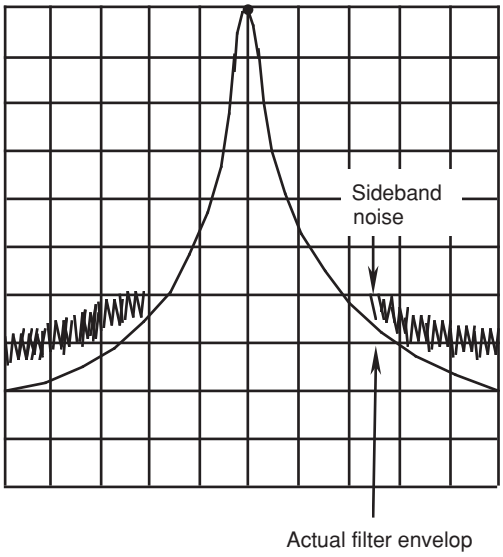
Resolution bandwidth	Frequency span	Video bandwidth	60 dB BW	3 dB BW	60 dB BW/30 dB BW
5 MHz	100 MHz	100 Hz			≤15
1 MHz	20 MHz	100 Hz			≤15
300 kHz	10 MHz	100 Hz			≤10
100 kHz	5 MHz	100 Hz			≤10
30 kHz	1 MHz	100 Hz			≤10
10 kHz	200 kHz	100 Hz			≤10
3 kHz	100 kHz	100 Hz			≤10
1 kHz	50 kHz	100 Hz			≤10

• MS2661C/2663C

Resolution bandwidth	Frequency span	Video bandwidth	60 dB BW	3 dB BW	60 dB BW/30 dB BW
3 MHz	100 MHz	100 Hz			≤15
1 MHz	20 MHz	100 Hz			≤15
300 kHz	10 MHz	100 Hz			≤15
100 kHz	5 MHz	100 Hz			≤15
30 kHz	1 MHz	100 Hz			≤15
10 kHz	200 kHz	100 Hz			≤15
3 kHz	100 kHz	100 Hz			≤15
1 kHz	50 kHz	100 Hz			≤15

Sideband phase 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.

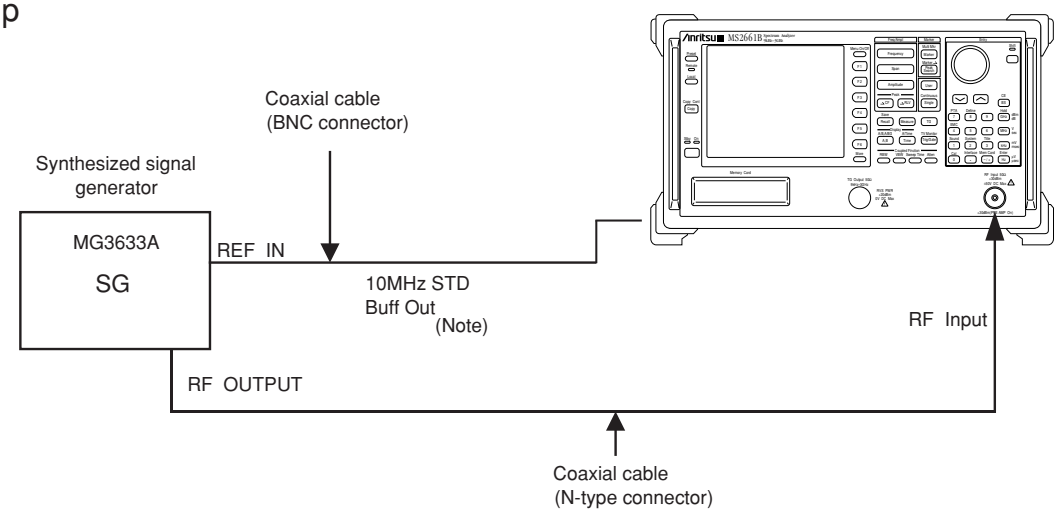
(1) Specifications

• Sideband noise: ≤-100 dBc/Hz (Frequency: 1 GHz, 10 kHz offset; MS2661B/2663B/2661C/2663C)
≤-90 dBc/Hz (Frequency: 1 GHz, 10 kHz offset; MS2651B/2653B)

(2) Test instruments

• Signal generator: MG3633A Synthesized Signal Generator

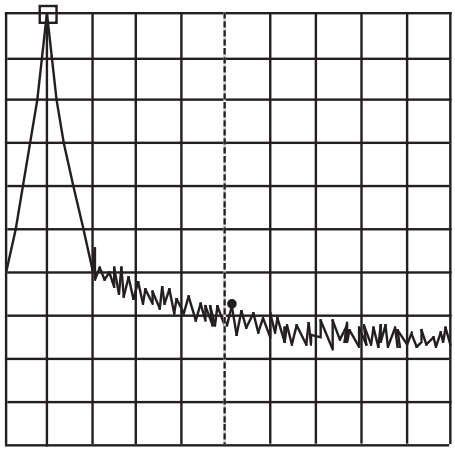
(3) Setup



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 knobto 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 (MS2661B/2663B/2661C/2663C) or -90 dBC/Hz or less (MS2651B/2653B).



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 with the higher-S/N signal, and test the frequency measurement accuracy using Count On mode.

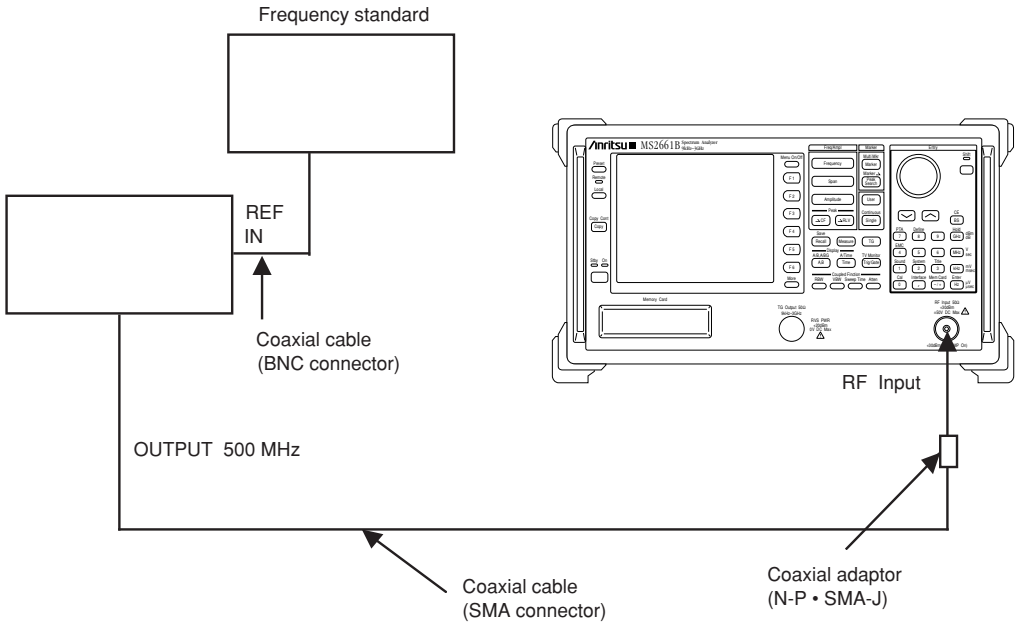
(1) Specifications

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

(2) Test instrument

- Signal generator: 69269A
- Frequency standard

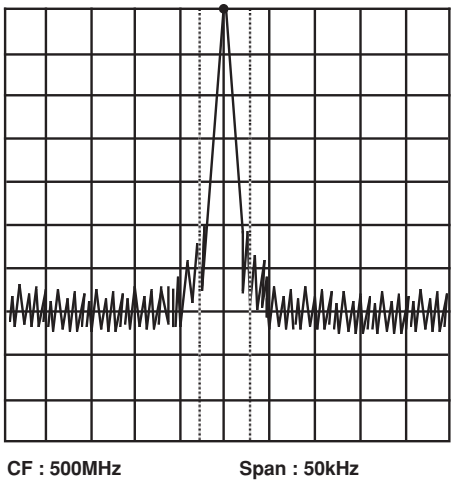
(3) Setup



Frequency Measurement Accuracy Test

(4) Procedure

Step	Procedure
1	Press the [Preset] key.
2	Set the 69269A to 500 MHz and -10 dBm.
3	Set the spectrum analyzer as shown below: Center Freq ..... 500 MHz Span ..... 50 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.

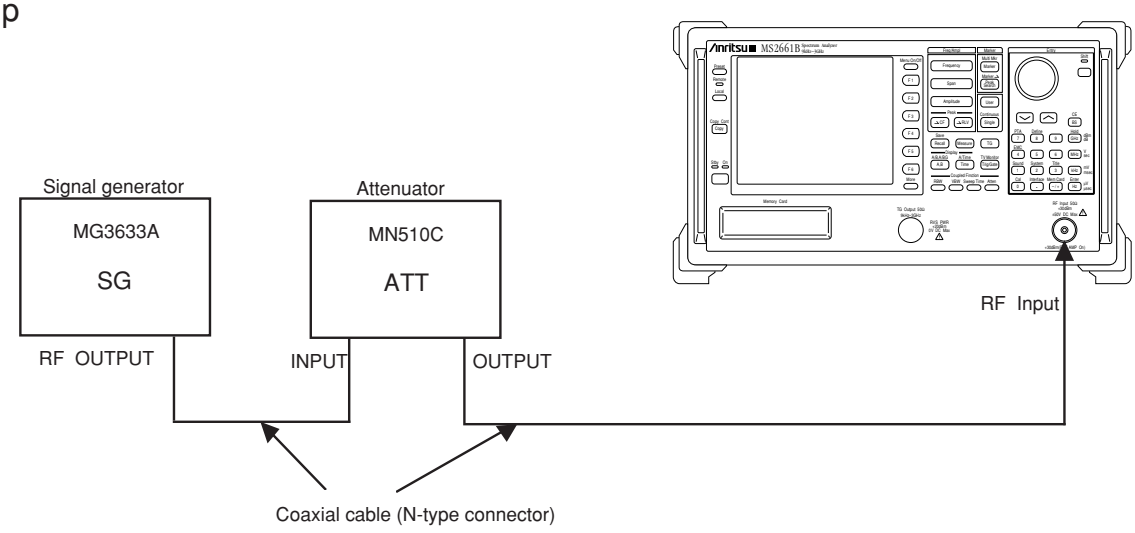
(1) Specifications

- Amplitude display linearity: After automatic calibration
  LOG: ±2.5 dB for 0 to -90 dB
  ±1.5 dB for 0 to -85 dB
  ±1 dB for 0 to -70 dB
  ±0.4 dB for 0 to -20 dB

(2) Test instruments

- Signal generator: MG3633A
- Attenuator: MN510C

(3) Setup



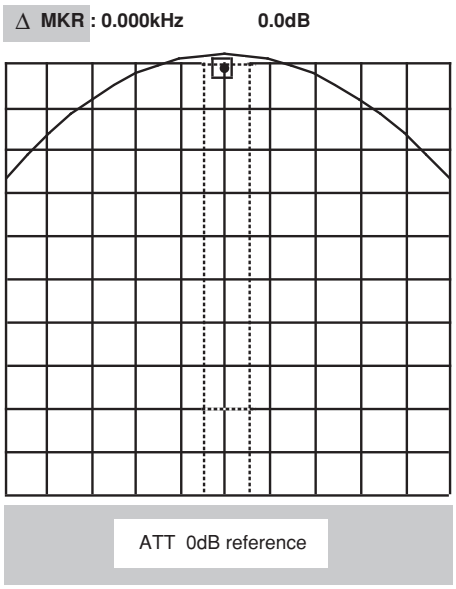
Amplitude Display Linearity Test

(4) Procedure

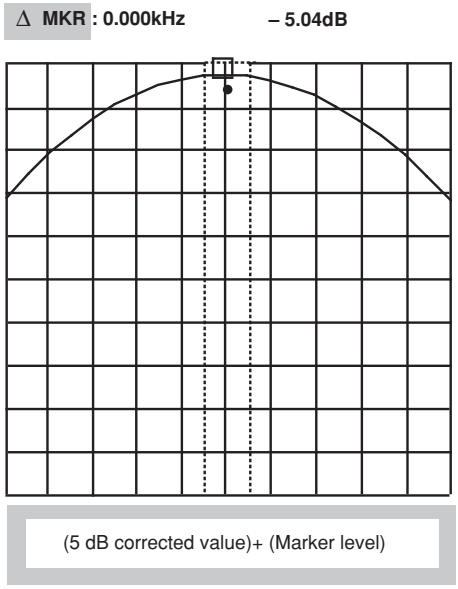
LOG display linearity

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 5 dB. 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) Δ Marker Level when ATT is 5

Log Display Linearity (10 dB/div)

ATT setting (dB)	A	B	Error (dB)=A+B
	ATT calibration value (dB)	Δ 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.

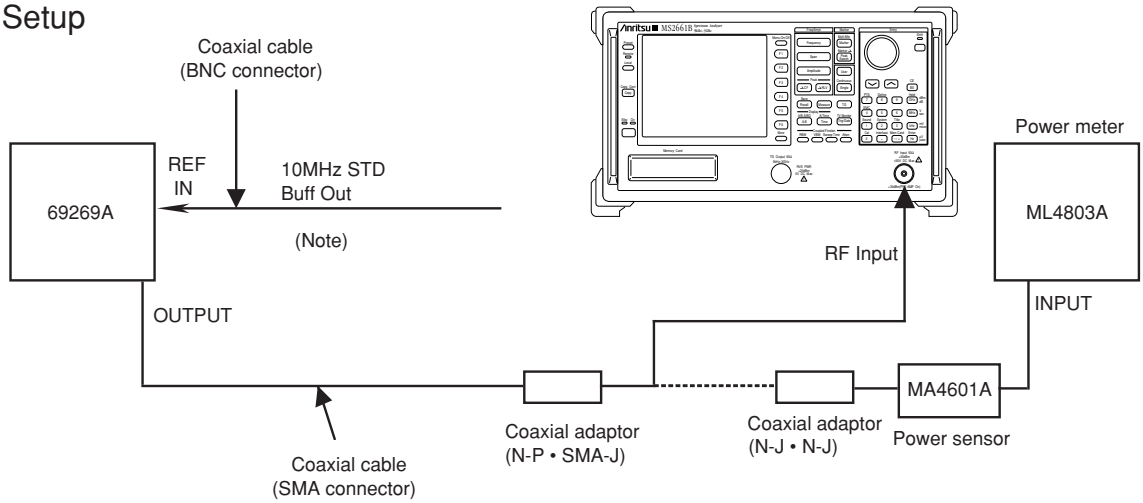
(1) Specifications

- Frequency response:
  - MS2651B/2661B/2661C ±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
    ±1.5 dB (9 to 100 kHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
    ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)
  - MS2653B/2663B/2663C ±0.5 dB (100 kHz to 3.2 GHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
    ±1.5 dB (9 to 100 kHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
    ±1.5 dB (2.92 to 8.1 GHz, band 1, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
    ±1.0 dB (100 kHz to 3.2 GHz, band 0, RF ATT: 10 to 50 dB)
    ±3.0 dB (2.92 to 8.1 GHz, band 1, RF ATT: 10 to 50 dB)
    * At band 1, pre-selector tuning

(2) Test instruments

- Signal generator: 69269A
- Power meter: ML4803A
- Power sensor: MA4601A (For the MS2651B/2661B/2661C)
  MA4701A (For the MS2653B/2663B/2663C)

(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 °C after allowing the instrument to warm up for 60 minutes or more.

(5) Procedure

(a) Calibration of signal-generator 69269A

Step	Procedure
1	Set the 69269A as shown below: OUTPUT FREQ ..... 100 MHz OUTPUT LEVEL ..... -10 dBm
2	Connect the 69269A output to the power sensor input with a coaxial cable.
3	Read the power meter display.
4	Change the 69269A 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 69269A 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 pre-selector is peaked. (See Section 8 of Vol.2, “Detailed Panel Operation.”)

Frequency Response

• MS2651B/2661B/2661C

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)

• MS2653B/2663B/2663C

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/MS2660B/C series.

(1) Specifications

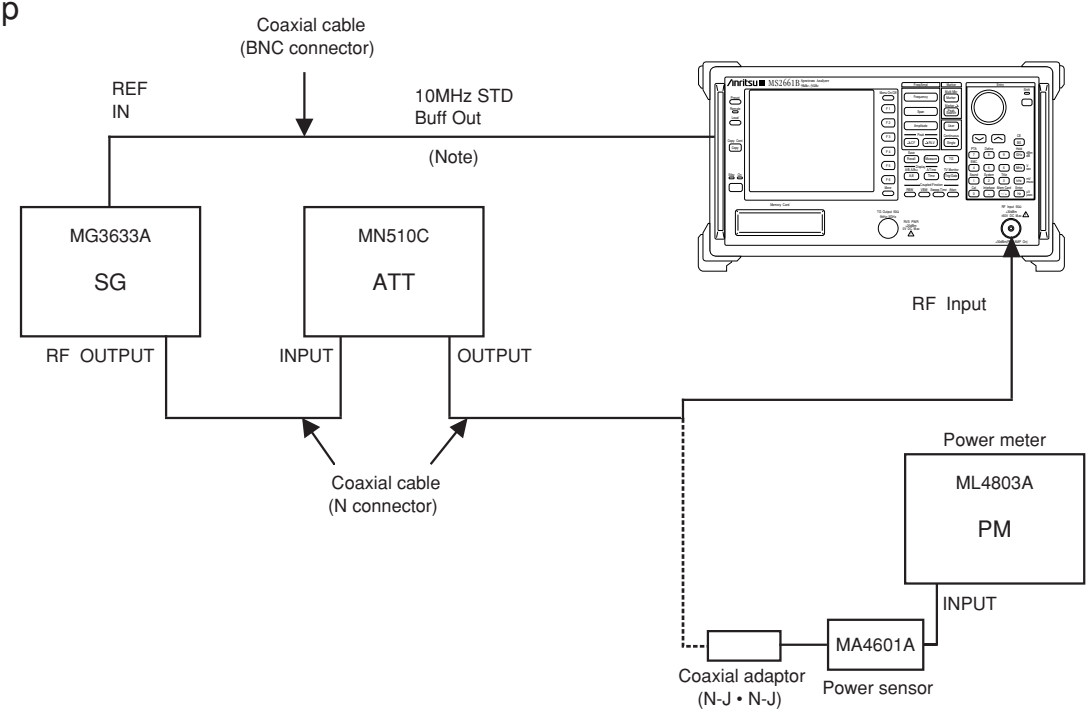
- Reference level accuracy: At 100 MHz frequency and 1 MHz span after automatic calibration
  (Resolution bandwidth, video bandwidth, RF ATT and sweep time set to AUTO)

  ≤ ± 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, RF ATT 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 ..... 1 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 readout	Correction factor of ATT	Error
0 dBm	dBm	dB	dB
–10 dBm	dBm	dB	dB
–20 dBm	dBm	dB	dB
–30 dBm	dBm	dB	dB
–40 dBm	dBm	dB	dB
–50 dBm	dBm	dB	dB
–60 dBm	dBm	dB	dB
–70 dBm	dBm	dB	dB
–80 dBm	dBm	dB	dB

10 Calculate the error from the following equation.

Error = Marker readout - reference level set value - correction factor of ATT

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.

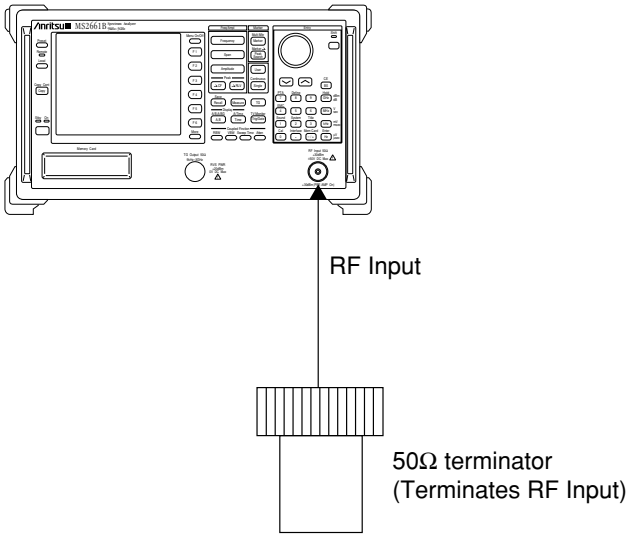
(1) Specifications

- Average noise level: At 1 kHz resolution bandwidth, 1 Hz video bandwidth, and 0 dB RF ATT:
  - MS2661B/2661C
    ≤-115 dBm (1 MHz to 1 GHz)
    ≤-115 dBm +f [GHz] dB (>1 GHz)
  - MS2651B
    ≤-110 dBm (1 MHz to 1 GHz)
    ≤-110 dBm +f [GHz] dB (>1 GHz)
  - MS2663B/2663C
    ≤-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 (2.92 to 8.1 GHz, Band 1)
  - MS2653B
    ≤-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 (2.92 to 8.1 GHz, Band 1)

(2) Test instruments

- 50 Ω terminator: MP752A

(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

MS2651B/2661B/2661C setting		Average noise level	
START FREQ	STOP FREQ	Marker readout	MS2651B/2661B/2661C specification
1 MHz	1 GHz		-110 dBm/-115 dBm
1 GHz	2 GHz		-109 to -108 dBm/ -114 to -113 dBm

MS2653B/2663B/2663C setting		Average noise level	
START FREQ	STOP FREQ	Marker readout	MS2653B/2663B/2663C specification
1 MHz	1 GHz		-115 dBm/-110 dBm
1 GHz	2 GHz		-113.5 to -112 dBm -118.5 to -107 dBm
4 MHz	6 GHz		-113 to -112 dBm -118 to -107 dBm
7 GHz	8 GHz		-111.5 to -111 dBm -106.5 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/MS2660B/C 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).

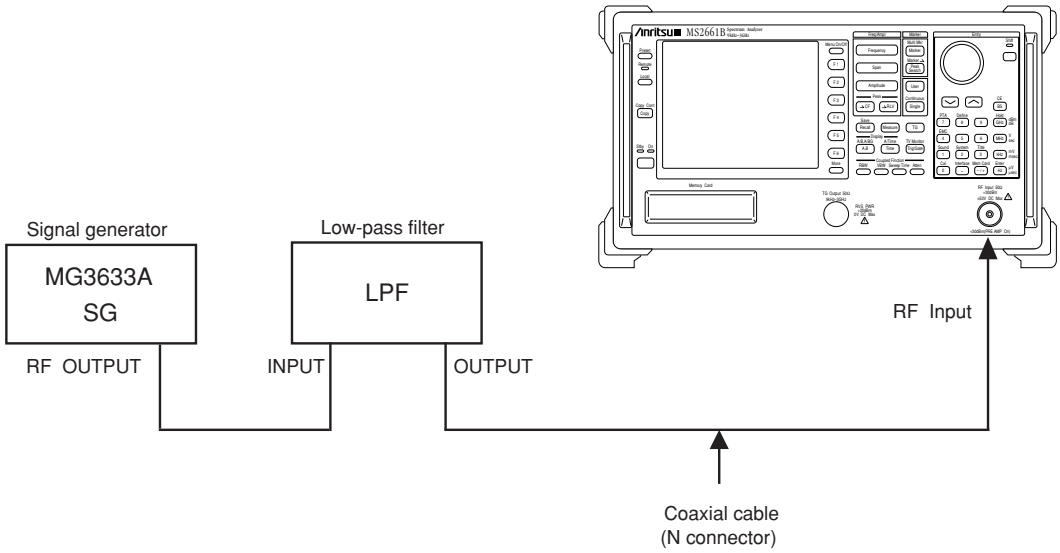
(1) Specifications

- Second harmonic distortion:
  - MS2661B/2661C — 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)
  - MS2651B — At mixer input level -30 dBm:
    ≤-55 dBc (input frequency 10 to 100 MHz)
    ≤-60 dBc (input frequency 100 to 1500 MHz)
  - MS2663B/2663C — 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 to 1 GHz, Band 0)
    At mixer input level -20 dBm:
    ≤-100 dBc (1.46 to 4.05 GHz, Band 1-/1+)
  - MS2653B — At mixer input level -30 dBm:
    ≤-55 dBc (10 to 100 MHz)
    ≤-60 dBc (0.1 to 1.55 GHz)
    At mixer input level -20 dBm:
    ≤-100 dBc (1.46 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

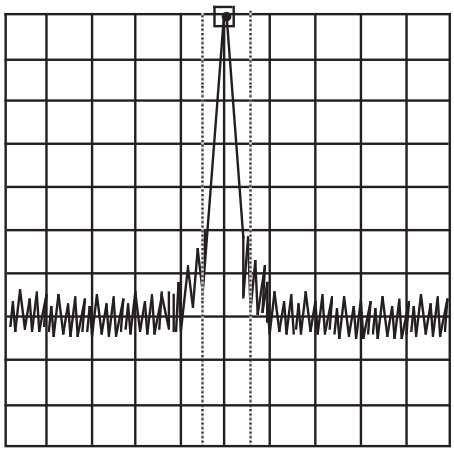
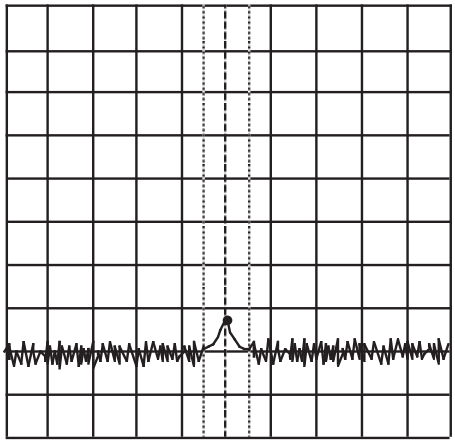
(3) Setup



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 Δ marker. 
8	Set the center frequency to twice the fundamental wave frequency to display the second harmonic on the screen. The Δ marker reading indicates the level difference between the fundamental wave and the second harmonic. If the level difference is 80 dB or more, set the REF LEVEL to -50 dBm. Confirm that the 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.

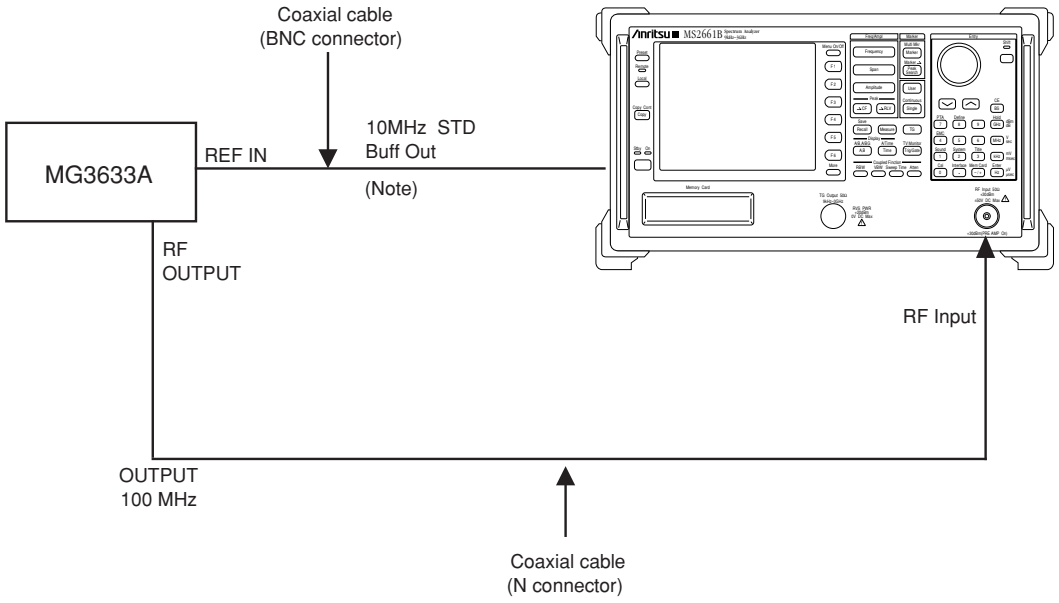
Resolution bandwidth (RBW) switching uncertainty

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

(1) Specifications

- Resolution bandwidth switching uncertainty: ± 0.3 dB (RBW=1 kHz to 1 MHz)
  (referenced to RBW: 3 kHz)
  ± 0.4 dB (RBW=5 MHz for MS2651B/2661B/2653B/2663B)
  ± 0.4 dB (RBW=3 MHz for MS2661C/2663C)

(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.

Resolution bandwidth (RBW) switching uncertainty

• MS2651B/2661B/2653B/2663B

MS2650/2660 series setting		Δ marker readout	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		±0.4 dB

• MS2661C/2663C

MS2650/2660 series setting		Δ marker readout	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
3 MHz	10 MHz		±0.4 dB

Input attenuator (RF ATT) switching uncertainty

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.

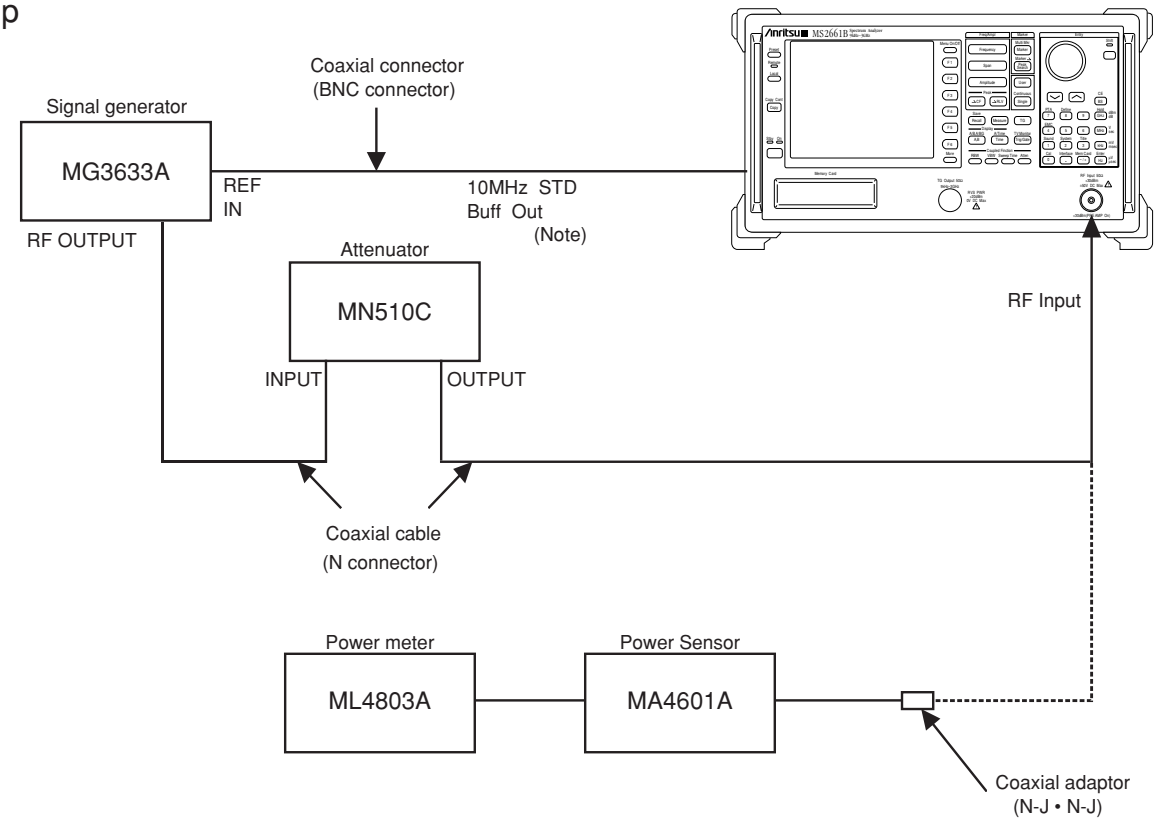
(1) Specifications

- 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, RF 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 readout - Reference Level - correction factor of attenuator
14	Find the deviation by the formula below: Deviation = Error - error when RF ATT at 10 dB Confirm that the deviation is within ±0.3 dB.

Spectrum analyzer setting		Attenuator setting	Correction factor of attenuator	Marker readout	Error	Deviation
REF LEVEL	RF 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

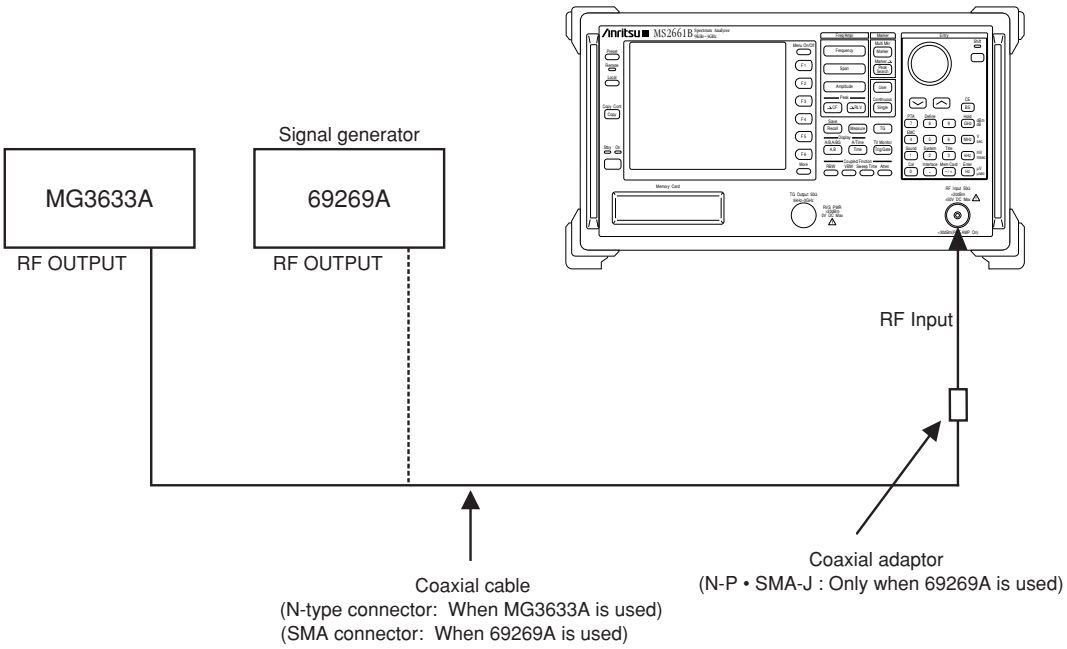
(1) Specifications

- 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
  69269A

(3) Setup



Sweep Time and Time Span Accuracy

(4) Procedure

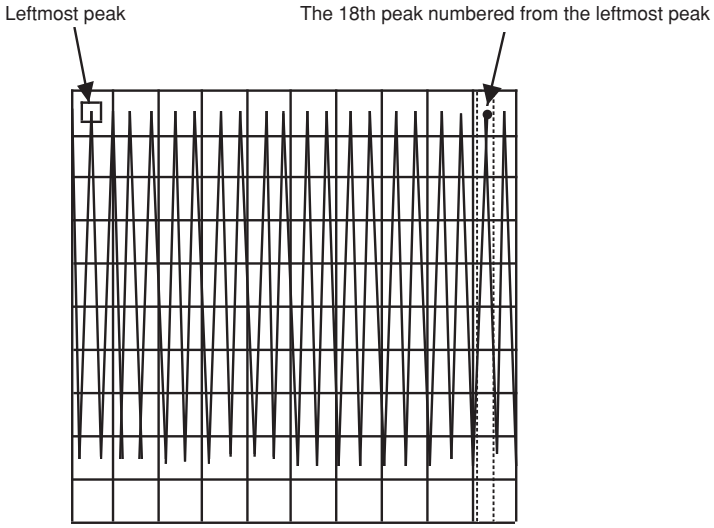
(a) Sweep Time

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 ..... 50 kHz SWP TIME ..... 50 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 ..... 400 Hz
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 frequency difference of the Δ marker, which corresponds to 90 % of the Sweep Time. Obtain the SWP TIME by the following equation. $\text{SWP TIME (measured)} = \text{Setting SWP TIME} \times \frac{\Delta \text{ marker readout}}{50000 \text{ (Hz)}}$

Step	Procedure

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

Spectrum analyzer Setting SWP TIME	Signal Generator AM modulation frequency	SWP TIME (measured)	Specification * min/max
50 msec	400 Hz		38.25 msec/51.75 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



* = Setting SWT TIME × (18/20) × accuracy

(b) Time span

Step	Procedure
1	Press the spectrum analyzer [Preset] key.
2	Operate All Cal.
3	Connect the MG3633A signal generator with the spectrum analyzer shown in the setup diagram.
4	Set the spectrum analyzer as shown below: CENTER FREQ ..... 100 MHz SPAN ..... 0 MHz SWEEP 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	Move the marker to the left of the screen using the knob and set the marker on the left most peak of the sine wave.
10	Setting the marker mode to Δ (delta), move the current marker to the right using the knob. Then set the marker to the 18th peak from the left most sine wave peak on the screen.
11	Read the time difference of the Δ marker, which corresponds to 90 % of the Time Span.
12	Measure at each setting shown in the table below according to step 4 to 11.

Spectrum analyzer time span	Signal Generator AM modulation frequency	Time Span (measured)	Specification * min/max
20 msec	1 kHz		17.82 msec/18.18 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

* = Setting Time Span × (18/20) × accuracy

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.

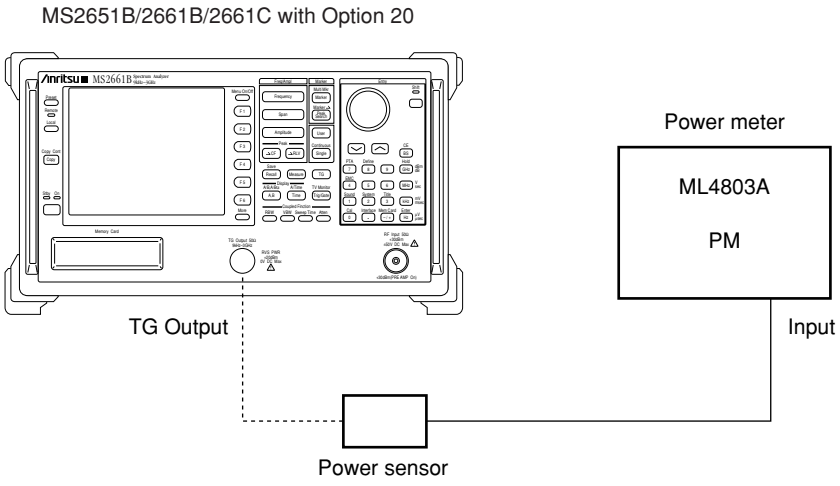
(1) Specifications

Output level range:	0 to -60 dBm
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 to -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/MS2660B/C series as well as the regular care procedures and the timing.

TABLE OF CONTENTS

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/MS2660B/C 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 °C or >70 °C) 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/MS2660B/C 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 before.

APPENDIXES

TABLE OF CONTENTS

APPENDIX A
FRONT AND REAR PANEL LAYOUT

This appendix shows the front and rear panel layout.

Fig. NO.	Name
Fig. A-1	MS2651B Front Panel
Fig. A-2	MS2651B (with Opt.22, 23) Front Panel
Fig. A-3	MS2653B Front Panel
Fig. A-4	MS2661B Front Panel
Fig. A-5	MS2661B (with Opt.22, 23) Front Panel
Fig. A-6	MS2663B Front Panel
Fig. A-7	MS2651B/2661B/2653B/2663B Rear Panel
Fig. A-8	MS2651B/2661B/2653B/2663B (with Opt.14) Rear Panel
Fig. A-9	MS2661C Front Panel
Fig. A-10	MS2661C (with Opt.22, 23) Front Panel
Fig. A-11	MS2663C Front Panel
Fig. A-12	MS2661C/2663C Rear Panel
Fig. A-13	MS2661C/2663C (with Opt.14) Rear Panel

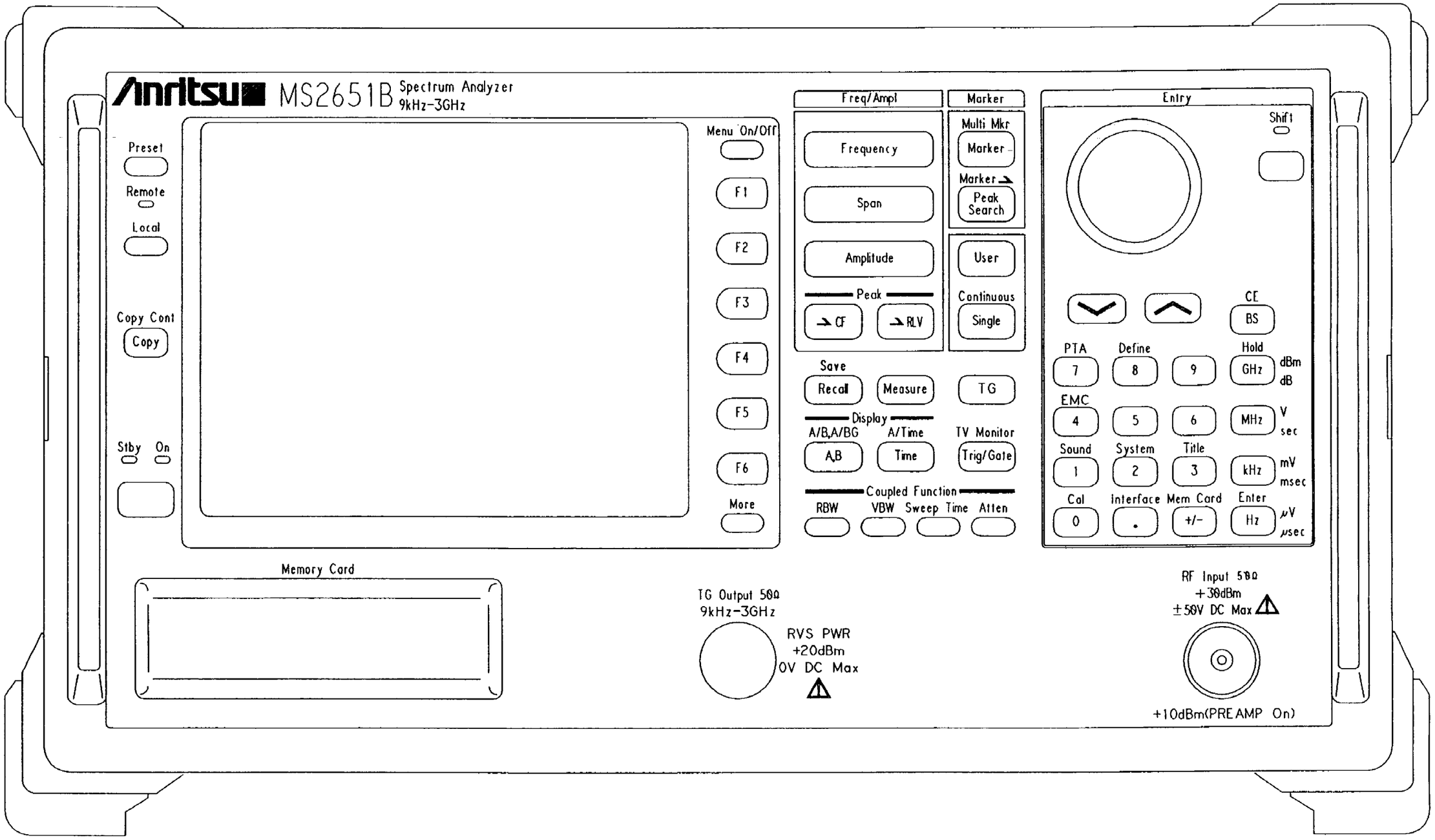


Fig. A-1 MS2651B Front Panel

APPENDIX A

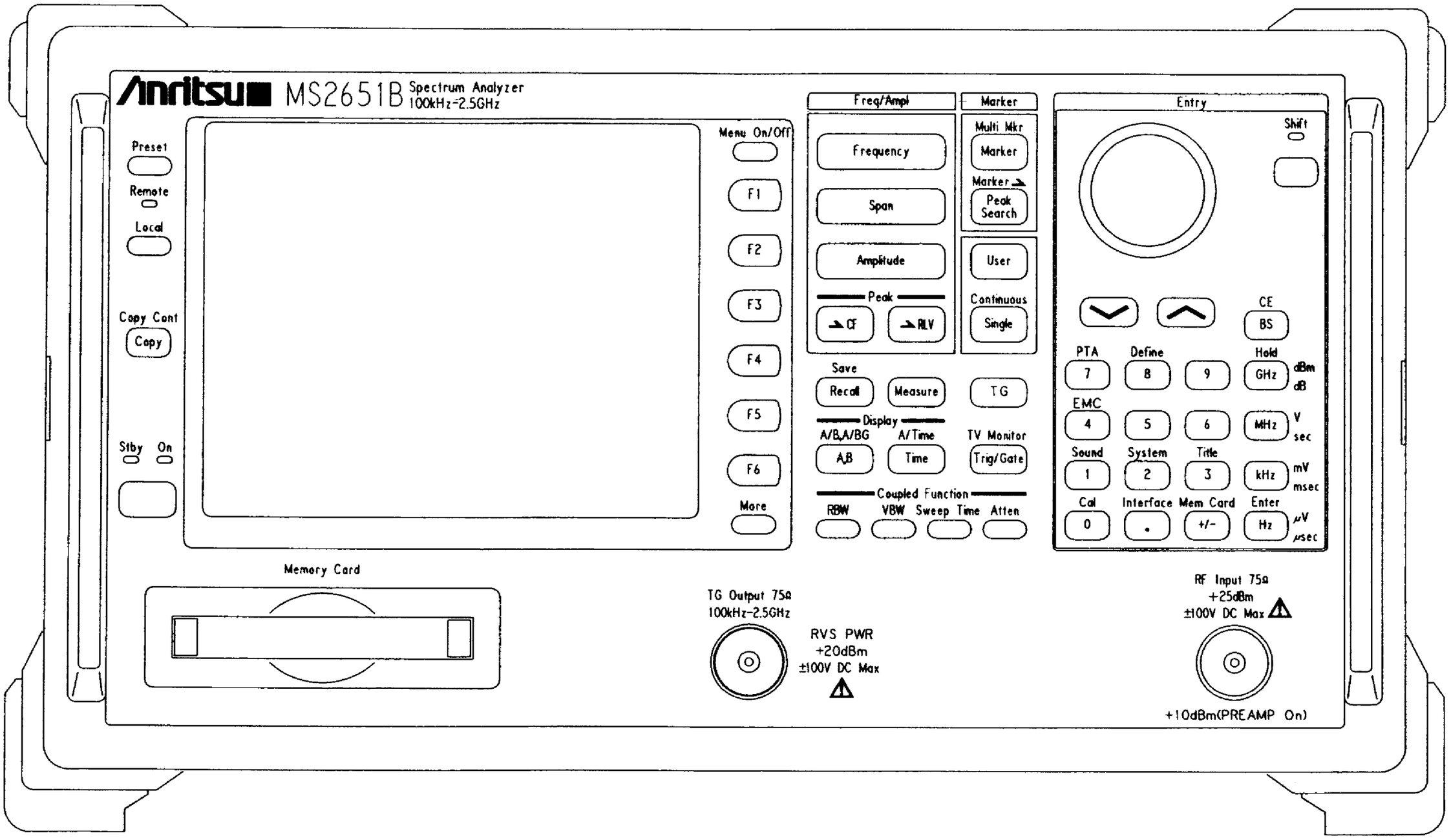


Fig. A-2 MS2651B (with Opt.22, 23) Front Panel

APPENDIX A

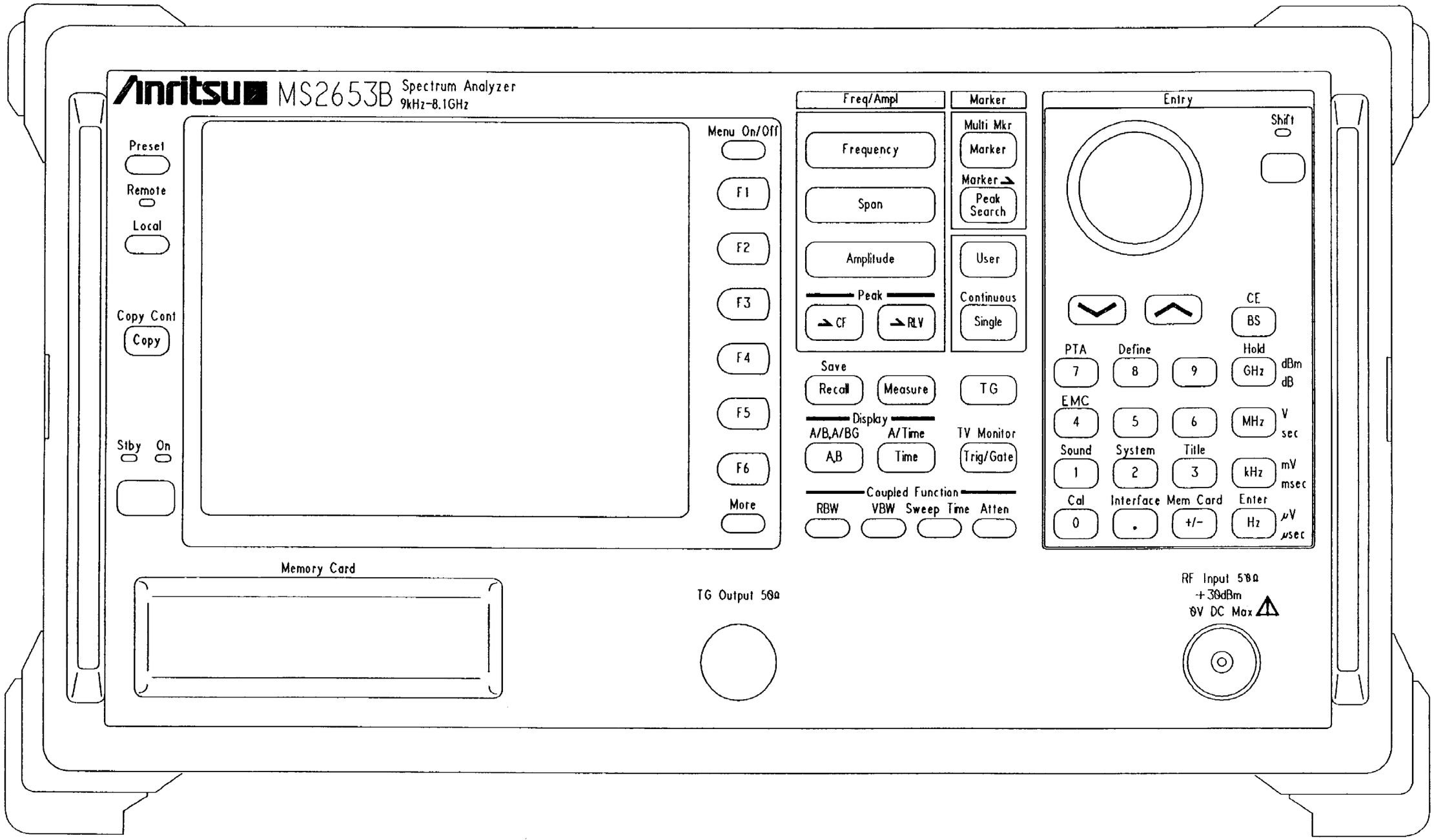


Fig. A-3 MS2653B Front Panel

APPENDIX A

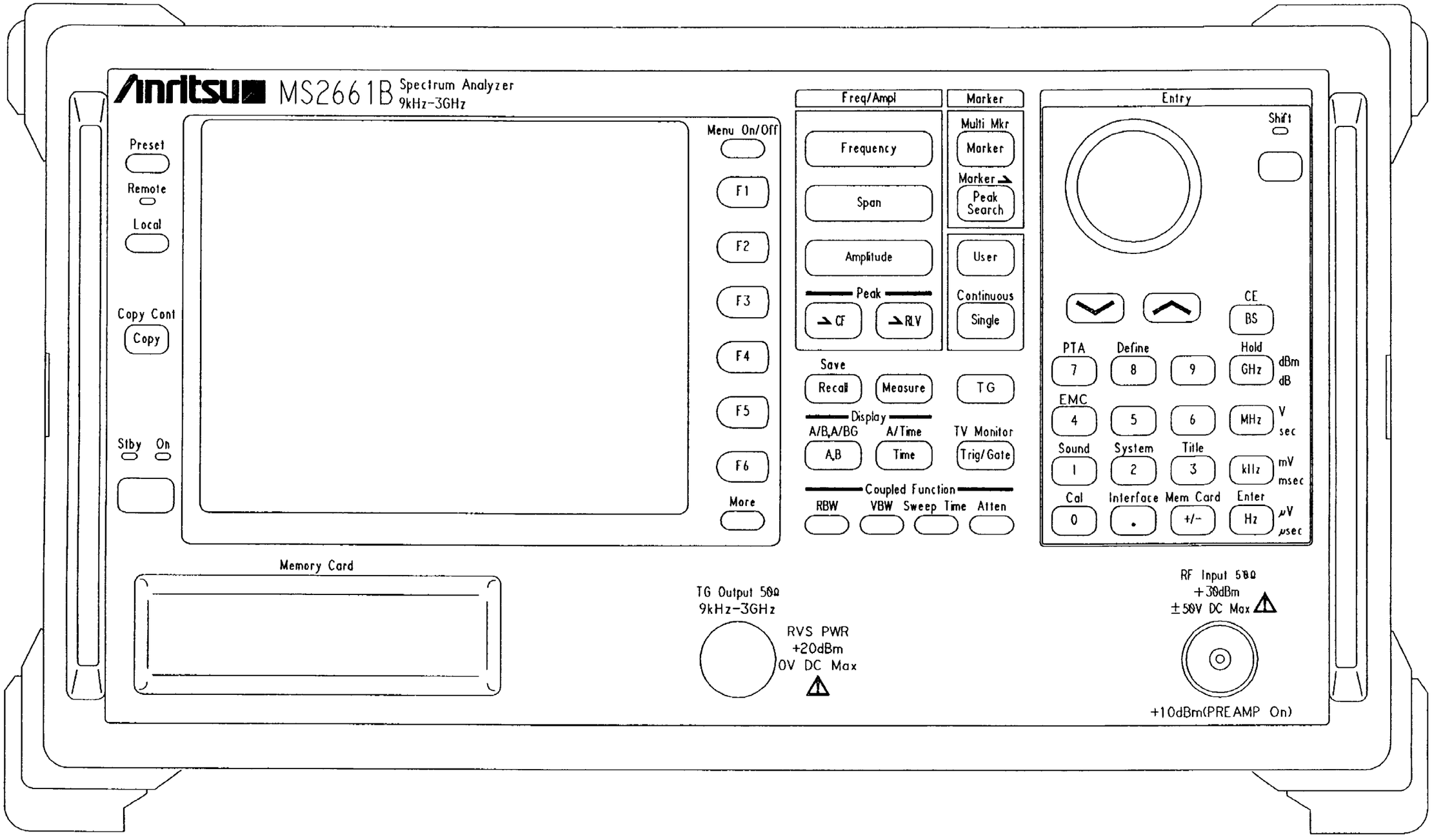


Fig. A-4 MS2661B Front Panel

APPENDIX A

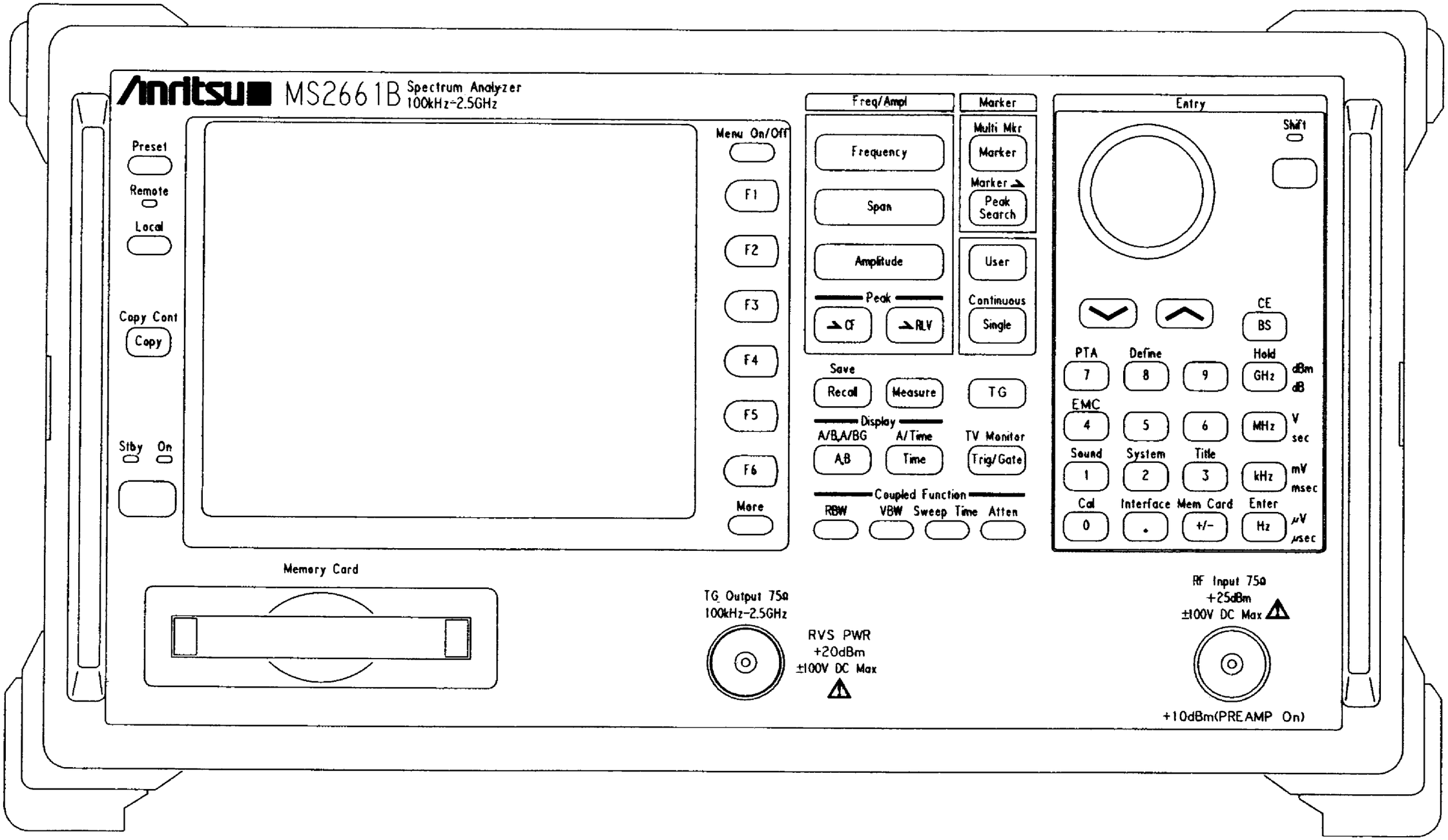


Fig. A-5 MS2661B (with Opt.22, 23) Front Panel

APPENDIX A

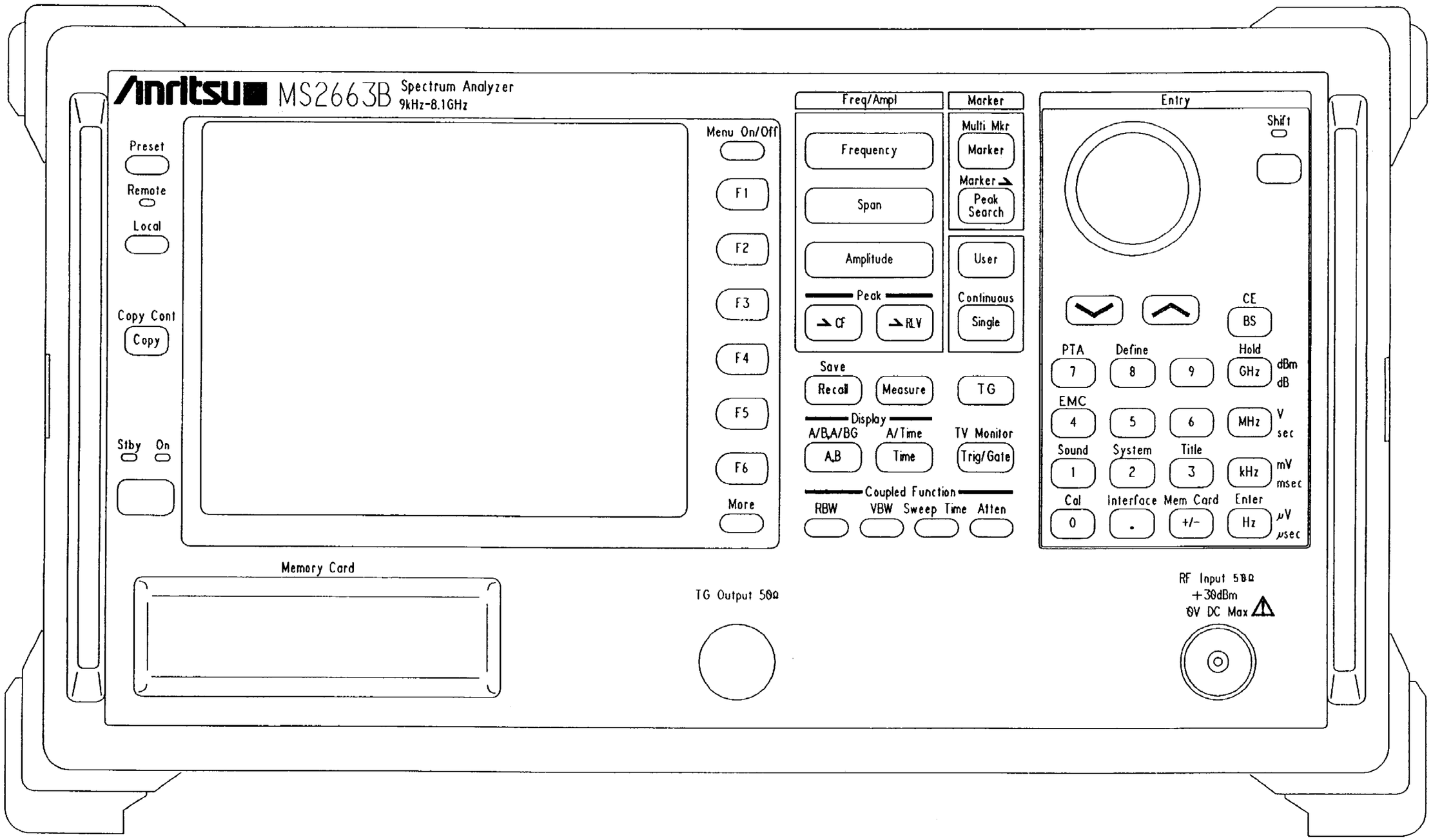
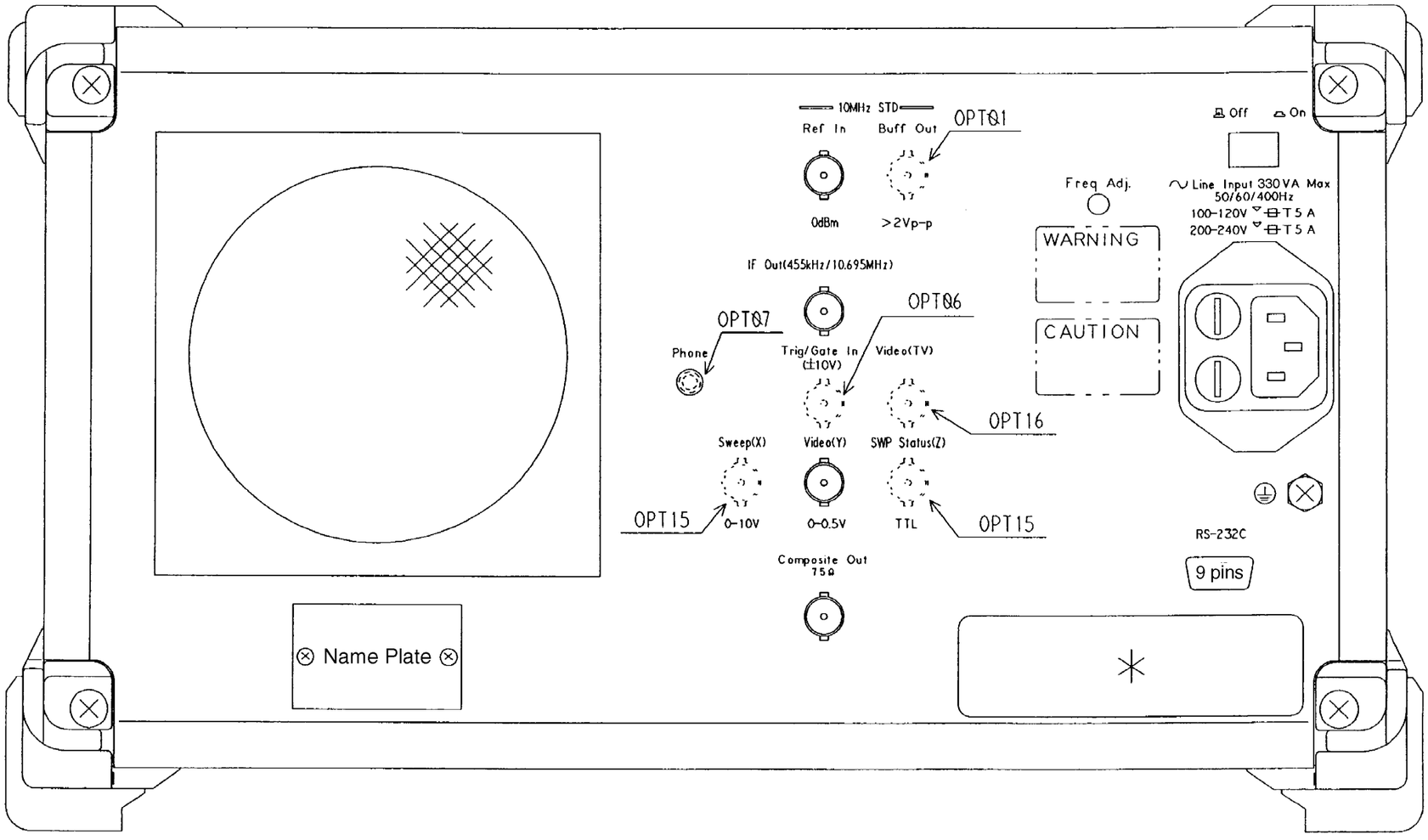
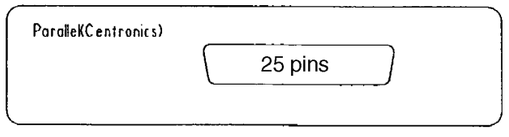


Fig. A-6 MS2663B Front Panel

APPENDIX A



*; OPT10



*; Standard

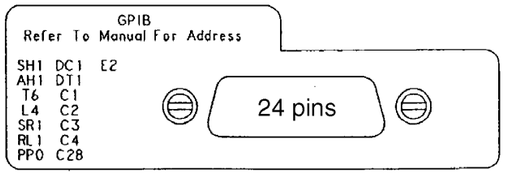


Fig. A-7 MS2651B/2661B/2653B/2663B Rear Panel

APPENDIX A

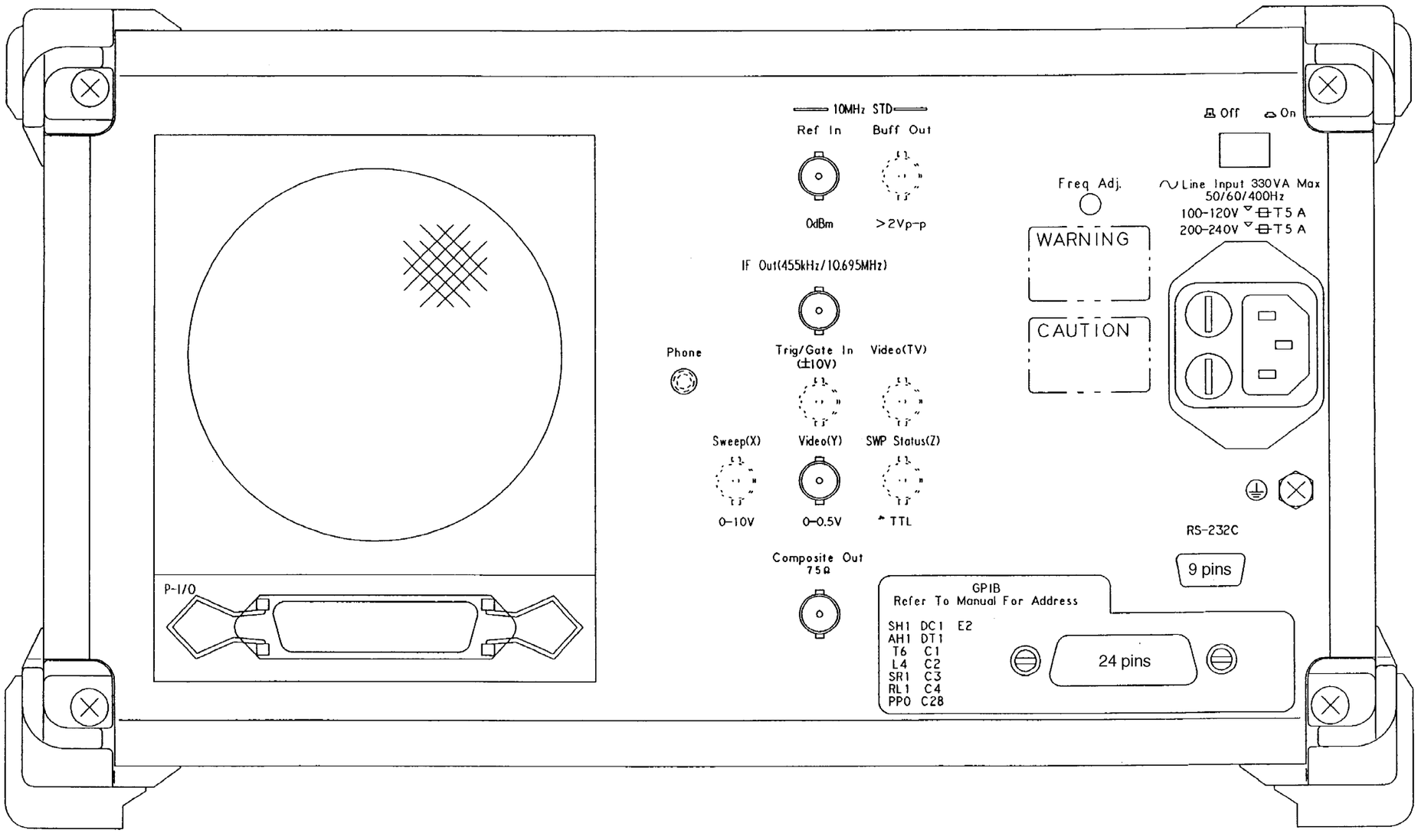


Fig. A-8 MS2651B/2661B/2653B/2663B (with Opt.14) Rear Panel

APPENDIX A

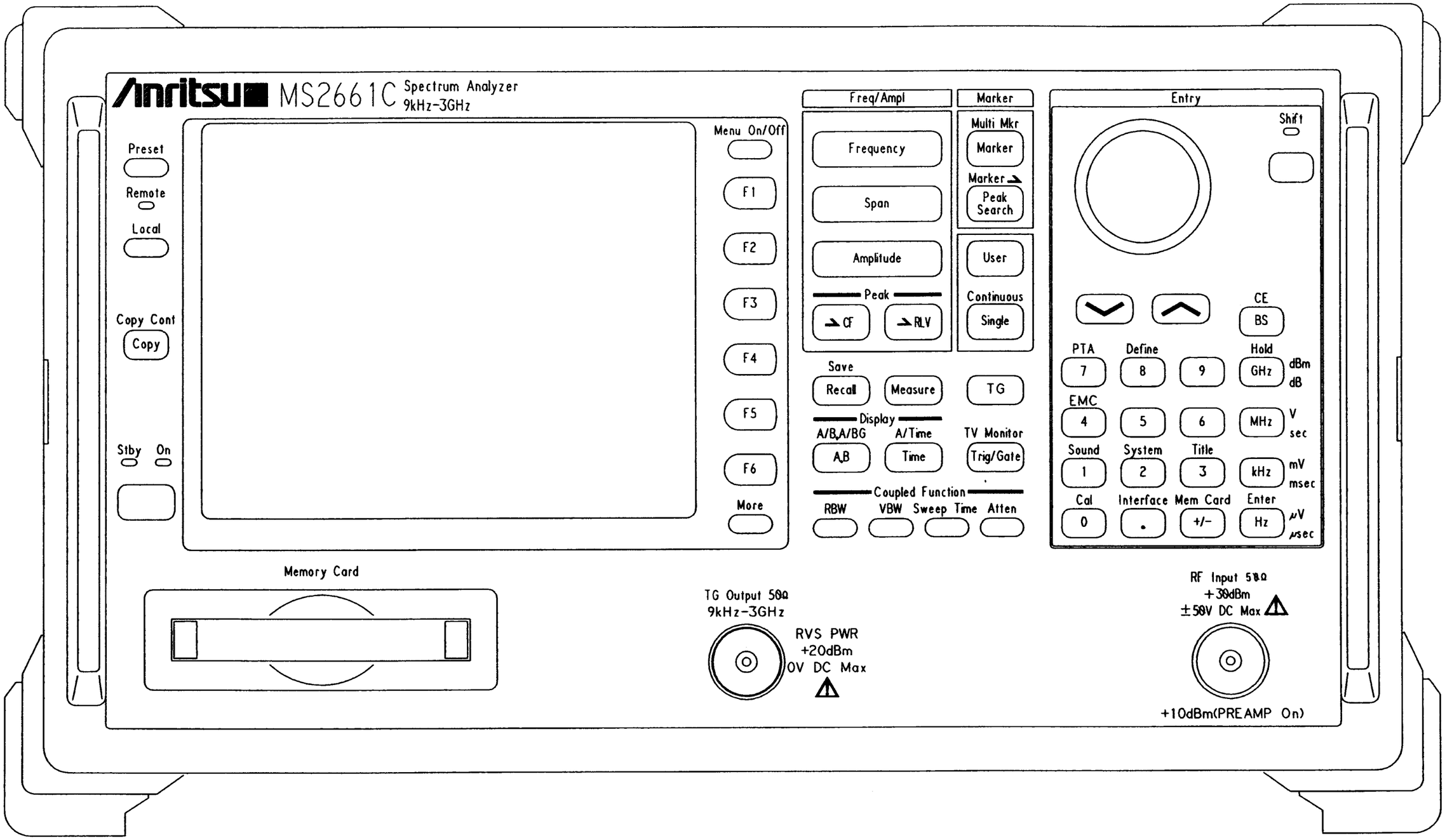


Fig. A-9 MS2661C Front Panel

APPENDIX A

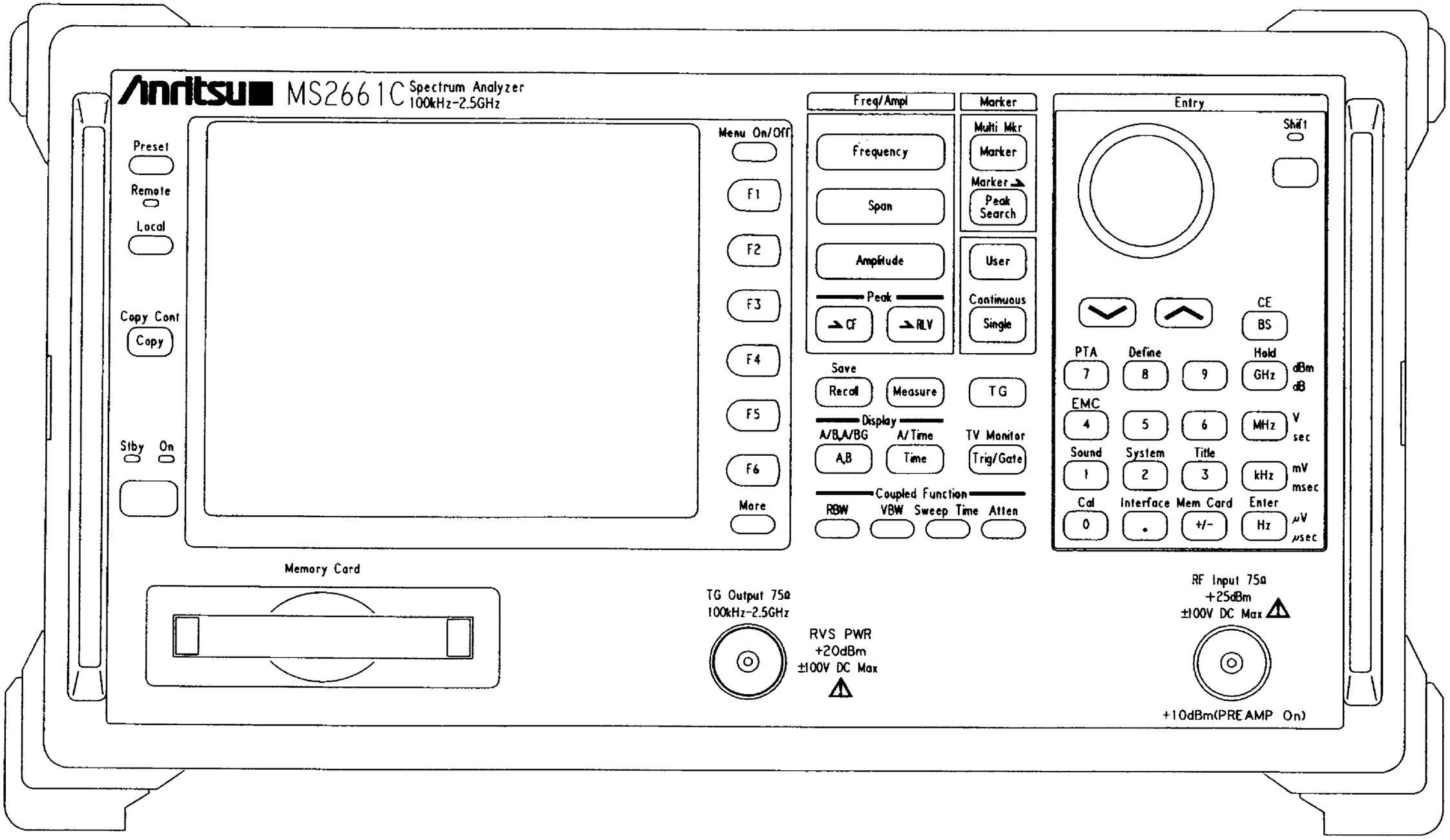


Fig. A-10 MS2661C (with Opt.22, 23) Front Panel

APPENDIX A

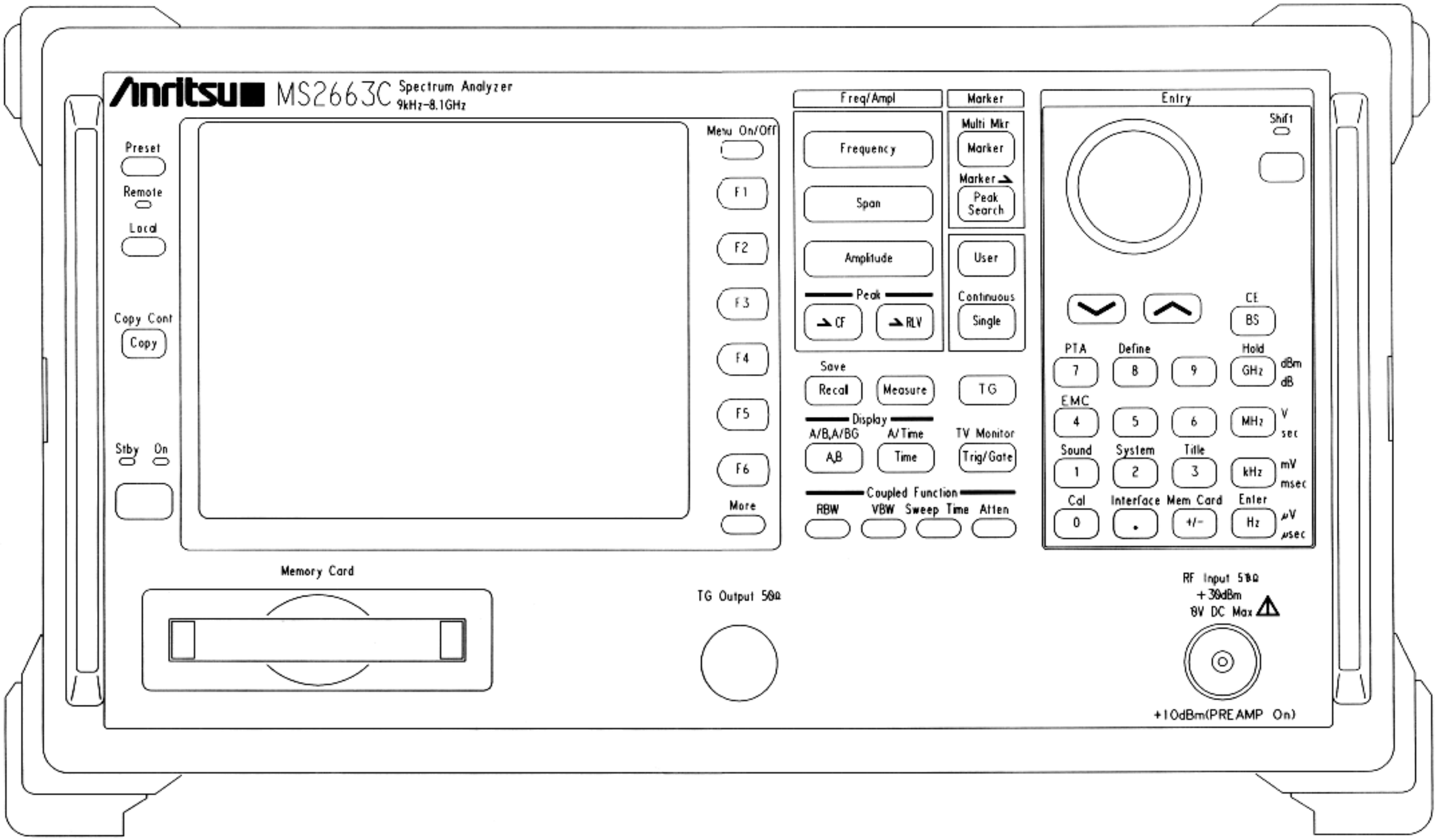
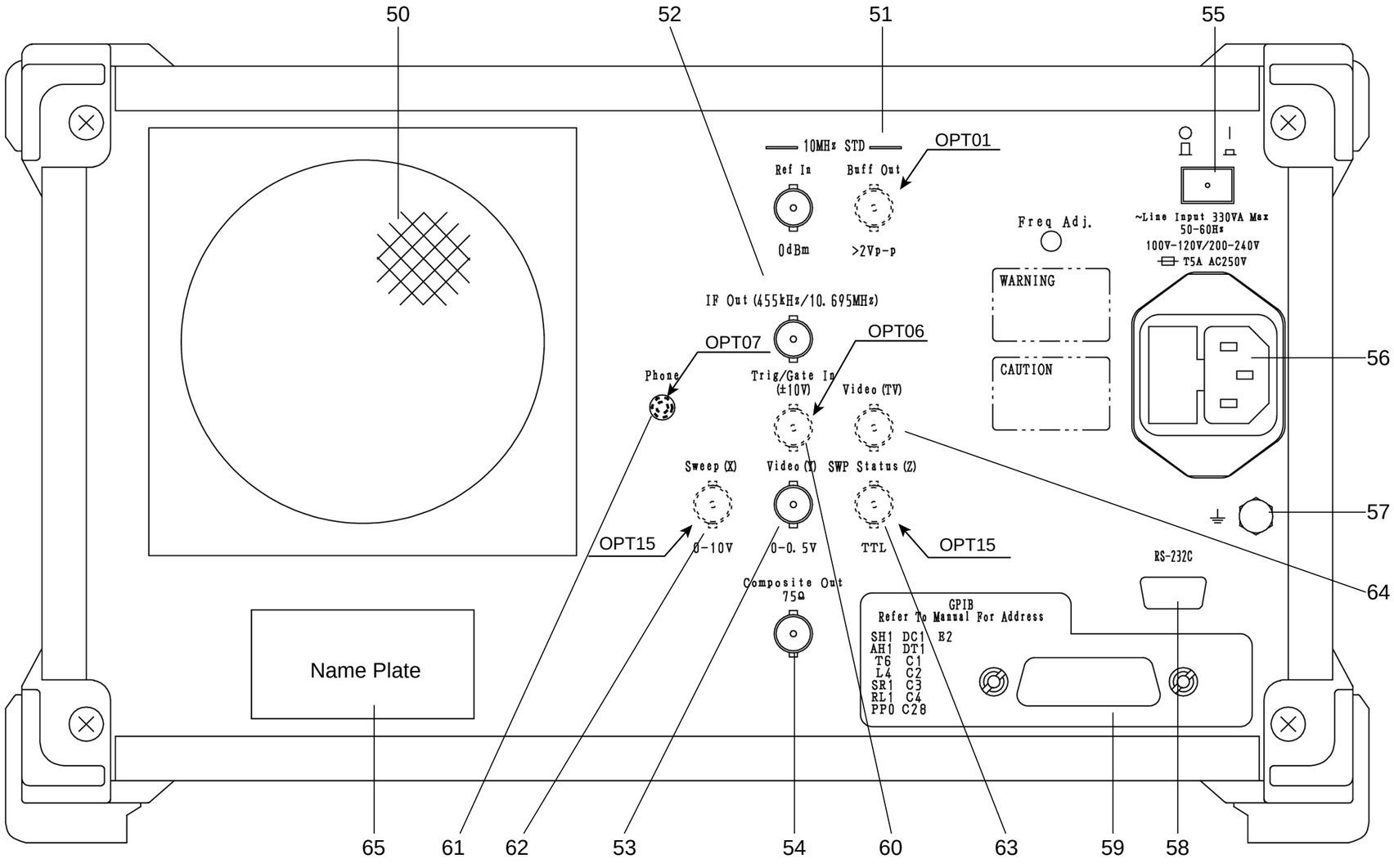


Fig. A-11 MS2663C Front Panel

APPENDIX A



＊ ; Option 10

PARALLEL (Centronics)

25 pins

＊ ; Standard

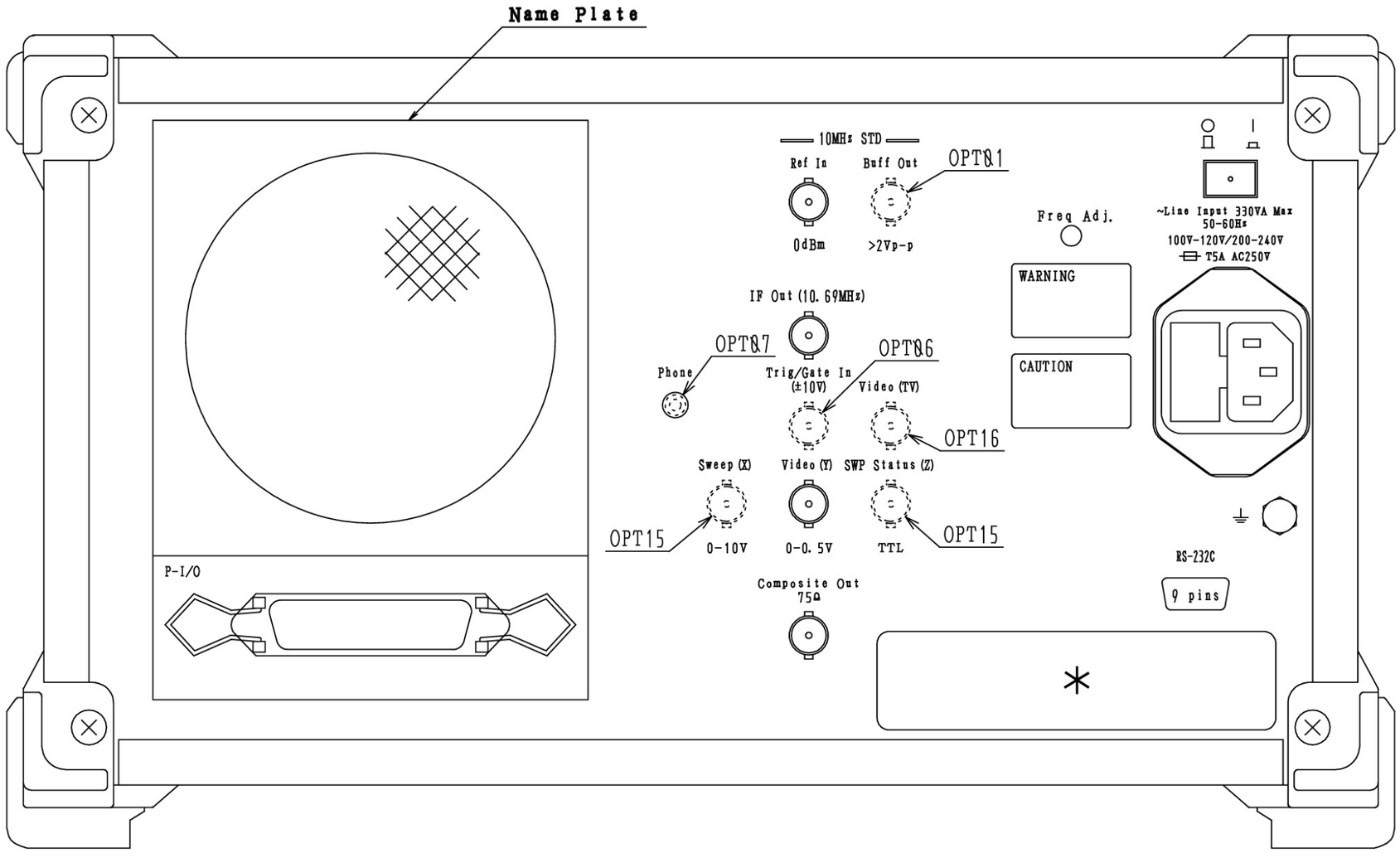
GPIB
Refer To Manual For Address

SH1 DC1 E2
AH1 DT1
T6 C1
L4 C2
SR1 C3
RL1 C4
PPO C28

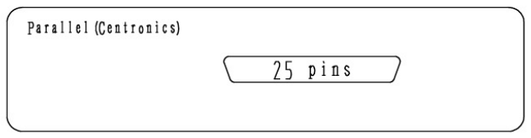
24 pins

Fig. A-12 MS2661C/2663C Rear Panel

APPENDIX A



*:OPT10



*:Standard

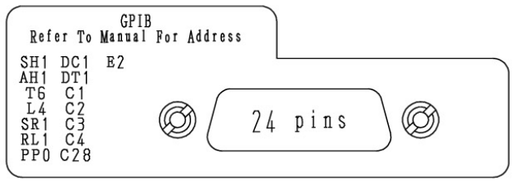


Fig. A-13 MS2661C/2663C (with Opt.14) Rear Panel

APPENDIX A

APPENDIX B
BLOCK DIAGRAM

This appendix shows the Block Diagram of the MS2651B/MS2661B and MS2653B/MS2663B and MS2661C and MS2663C.

Fig. NO.	Name
Fig. B-1	MS2651B/2661B Block Diagram (1/4)
Fig. B-2	MS2651B/2661B Block Diagram (2/4)
Fig. B-3	MS2651B/2661B Block Diagram (3/4)
Fig. B-4	MS2651B/2661B Block Diagram (4/4)
Fig. B-5	MS2653B/2663B Block Diagram (1/4)
Fig. B-6	MS2653B/2663B Block Diagram (2/4)
Fig. B-7	MS2653B/2663B Block Diagram (3/4)
Fig. B-8	MS2653B/2663B Block Diagram (4/4)
Fig. B-9	MS2661C Block Diagram (1/4)
Fig. B-10	MS2661C Block Diagram (2/4)
Fig. B-11	MS2661C Block Diagram (3/4)
Fig. B-12	MS2661C Block Diagram (4/4)
Fig. B-13	MS2663C Block Diagram (1/4)
Fig. B-14	MS2663C Block Diagram (2/4)
Fig. B-15	MS2663C Block Diagram (3/4)
Fig. B-16	MS2663C Block Diagram (4/4)

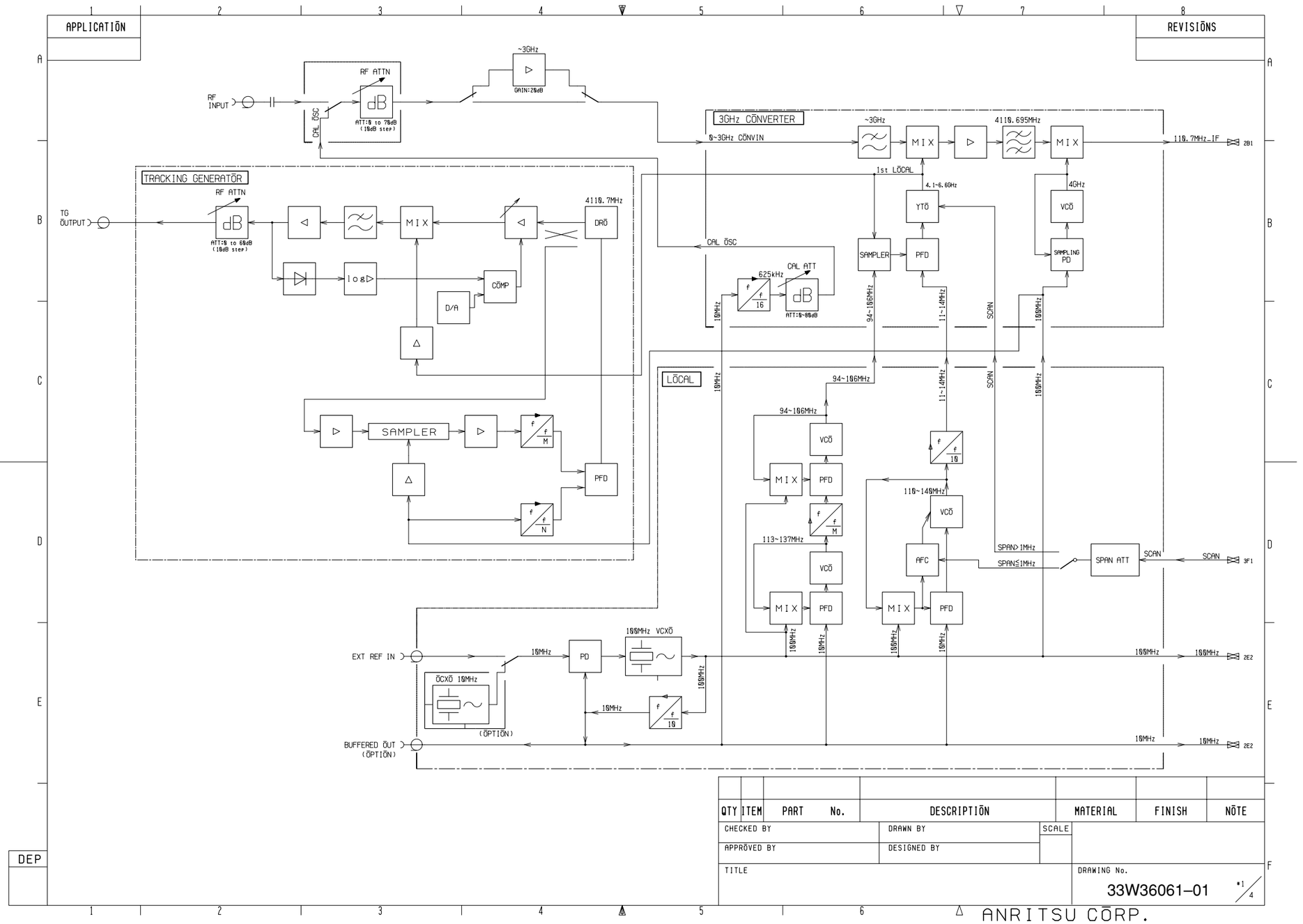


Fig. B-1 MS2651B/2661B Block Diagram (1/4)

APPENDIX B

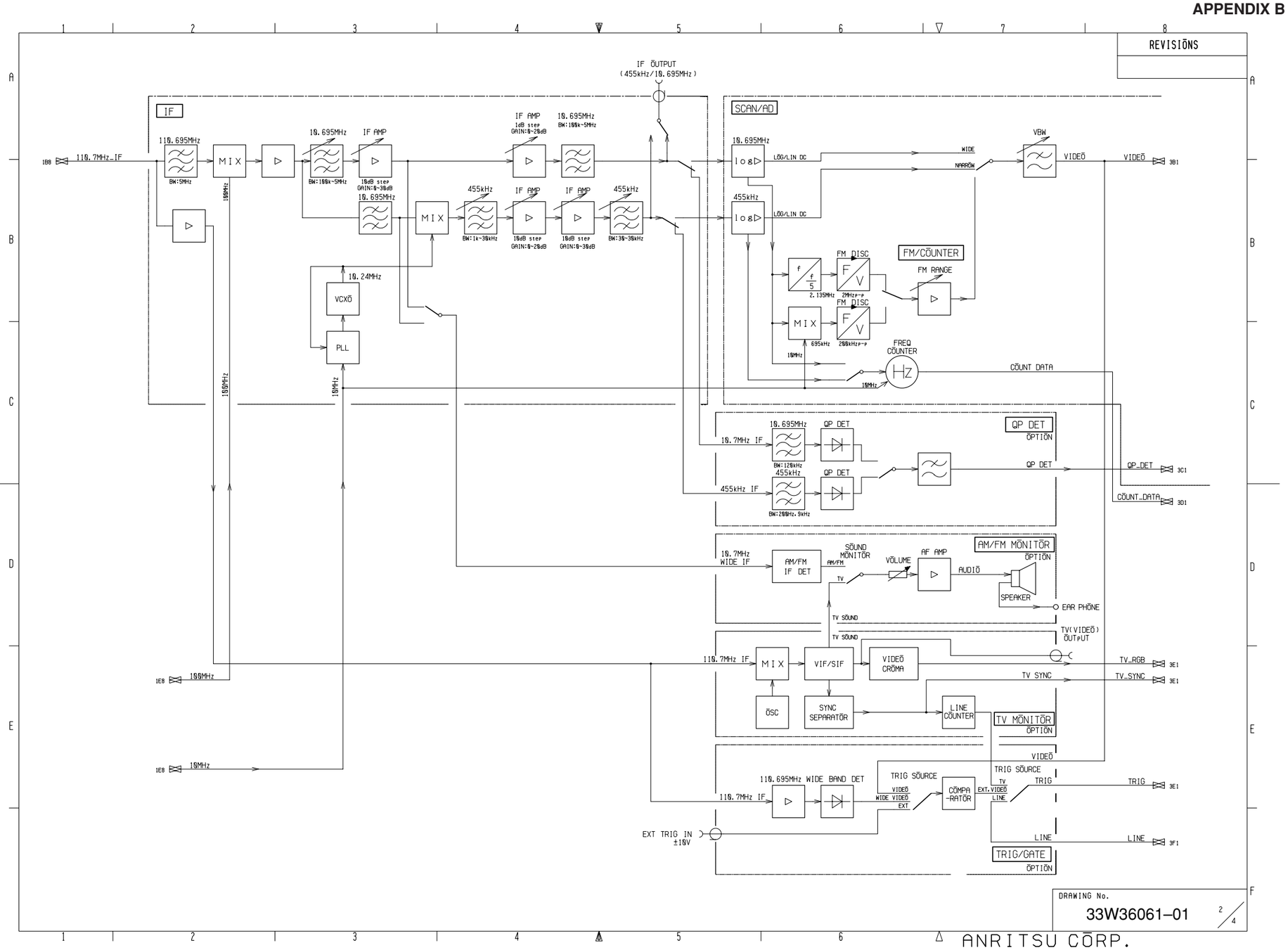


Fig. B-2 MS2651B/2661B Block Diagram (2/4)

APPENDIX B

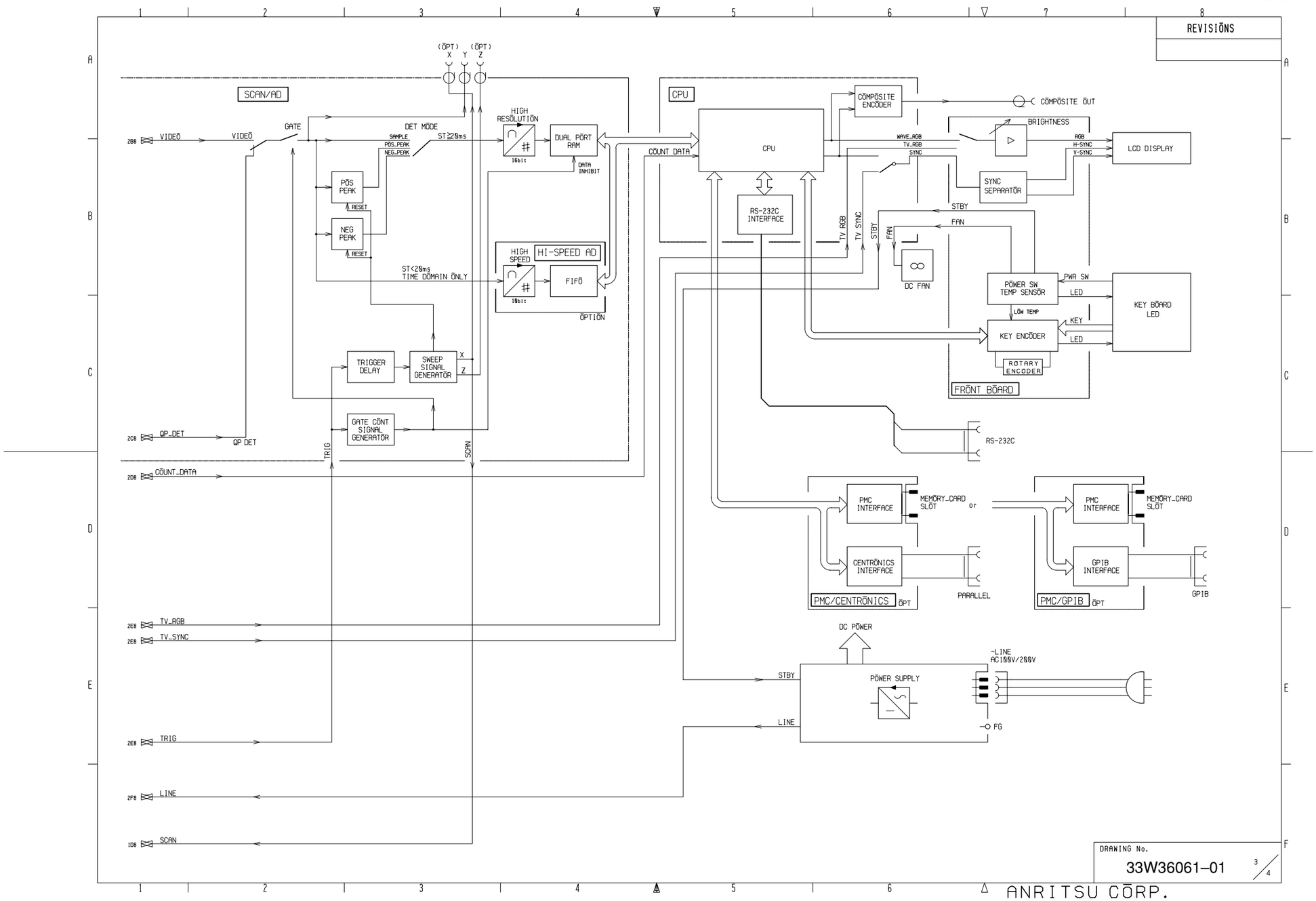


Fig. B-3 MS2651B/2661B Block Diagram (3/4)

APPENDIX B

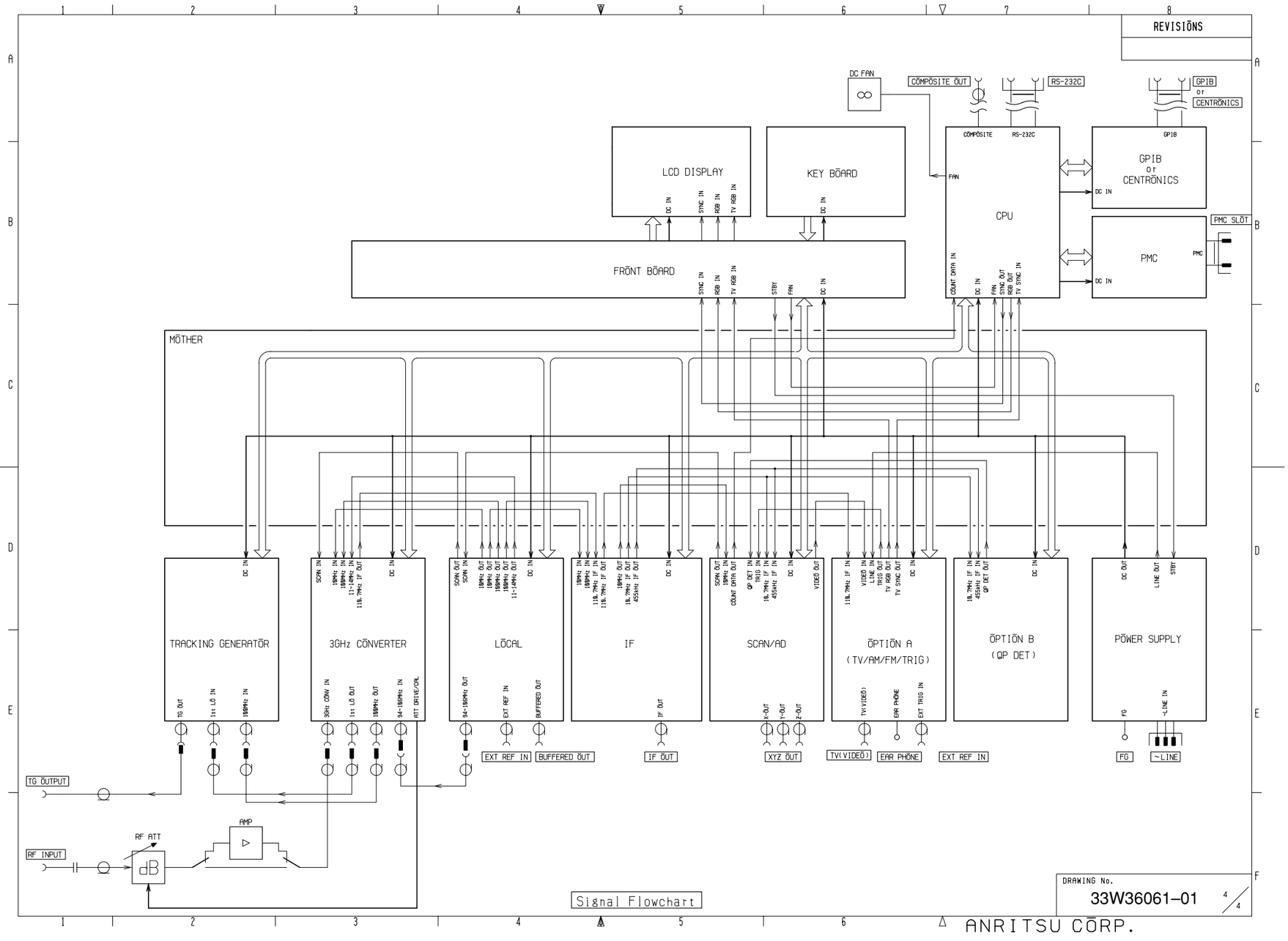


Fig. B-4 MS2651B/2661B Block Diagram (4/4)

APPENDIX B

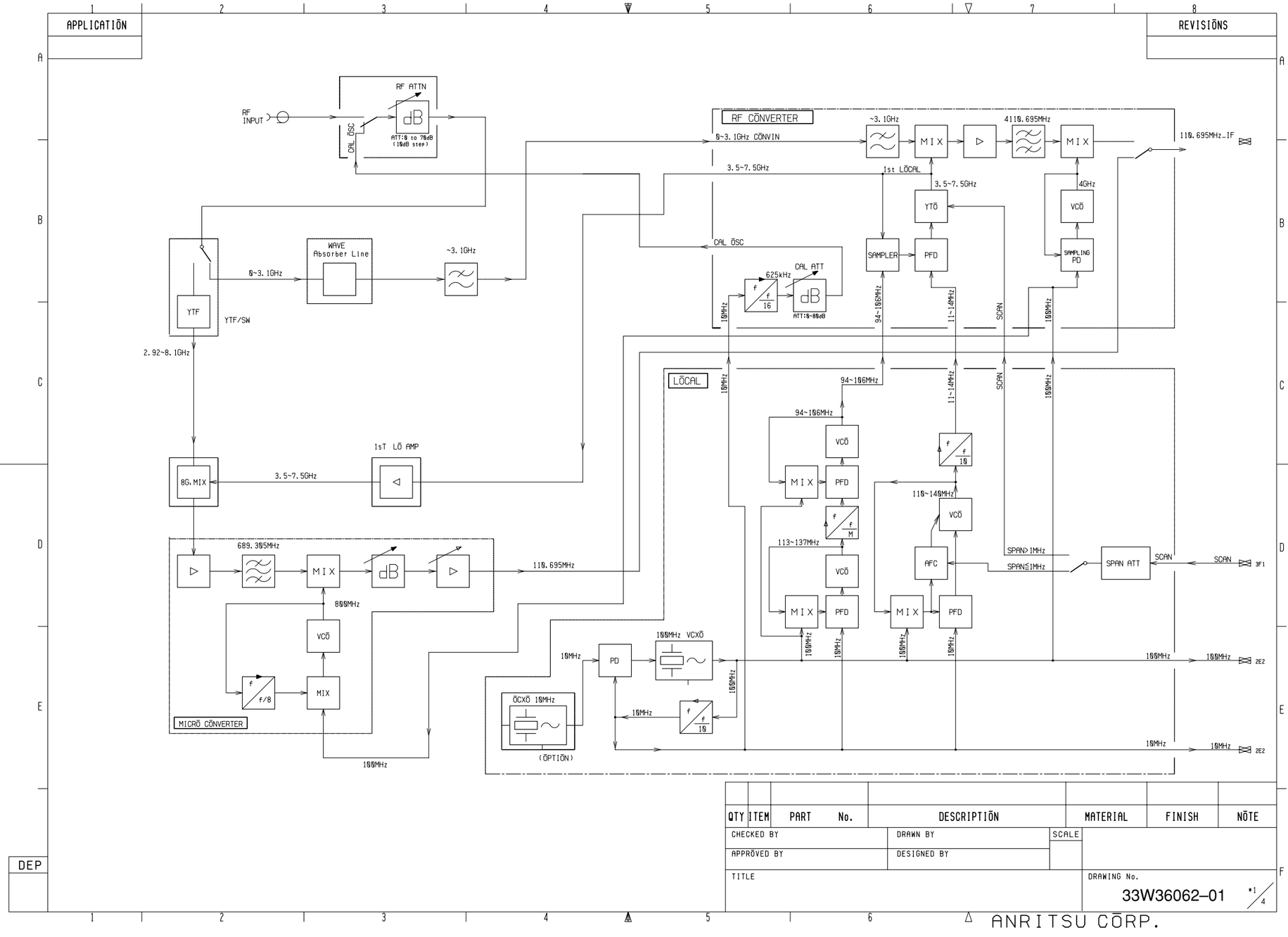


Fig. B-5 MS2653B/2663B Block Diagram (1/4)

APPENDIX B

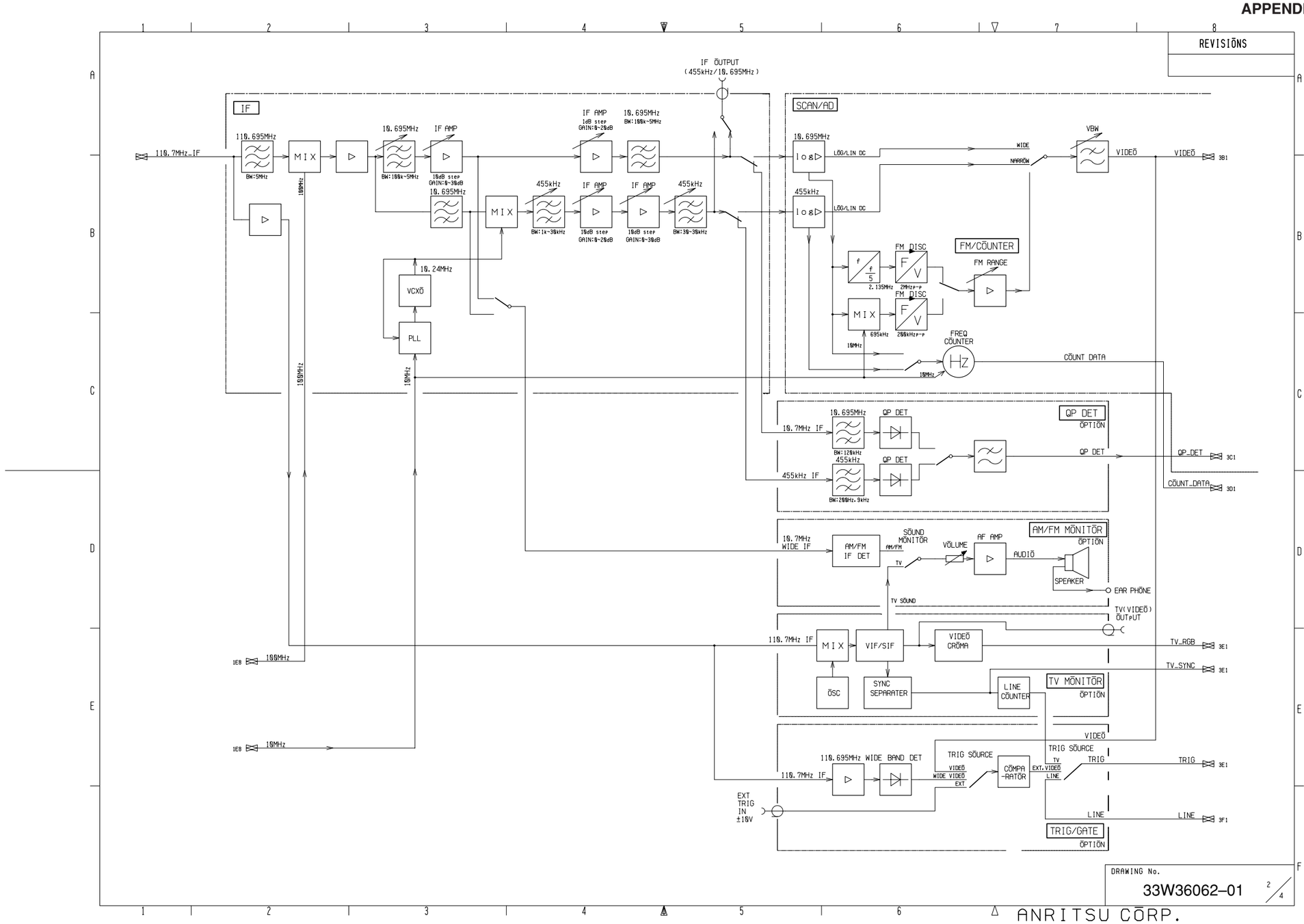


Fig. B-6 MS2653B/2663B Block Diagram (2/4)

APPENDIX B

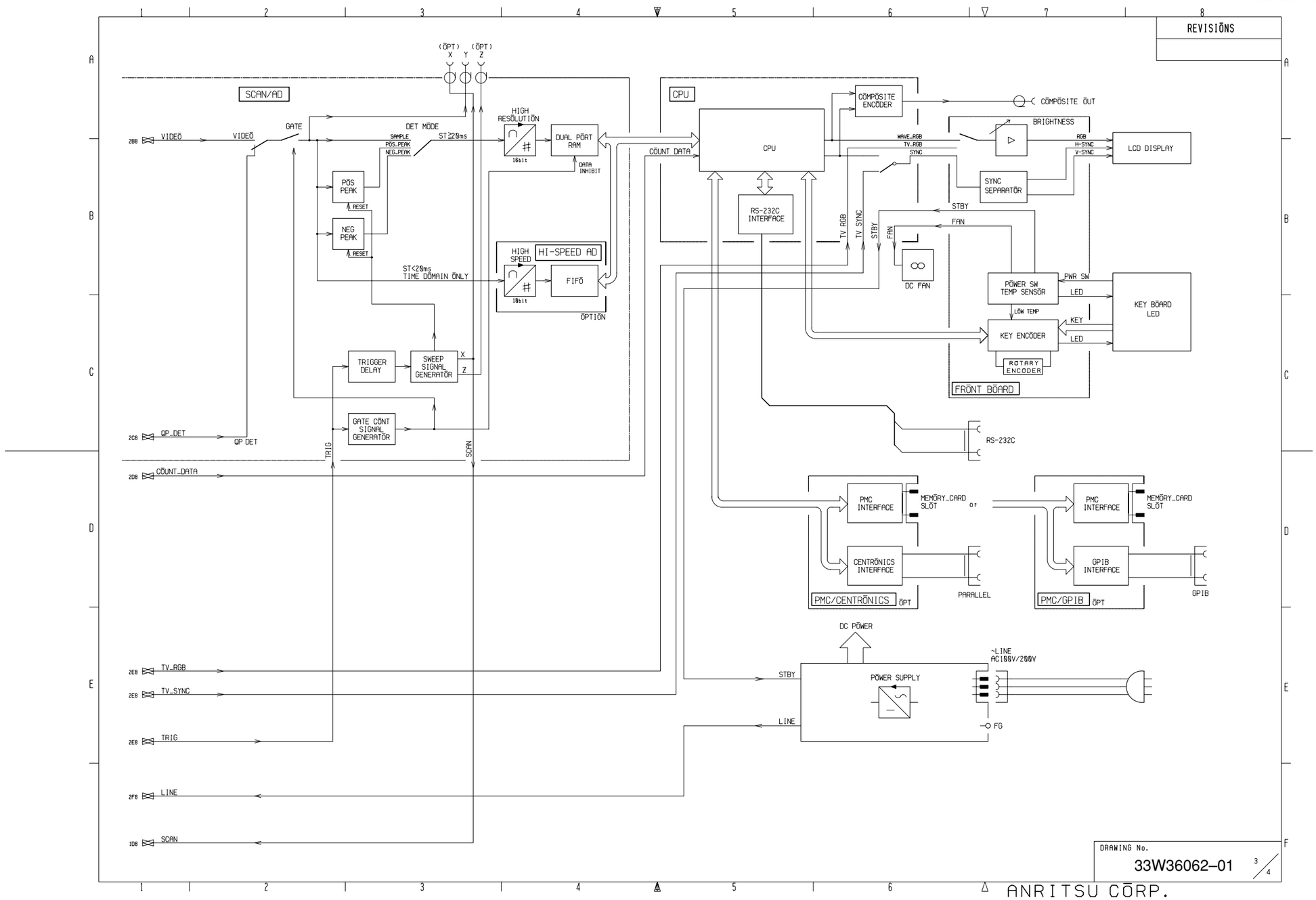


Fig. B-7 MS2653B/2663B Block Diagram (3/4)

APPENDIX B

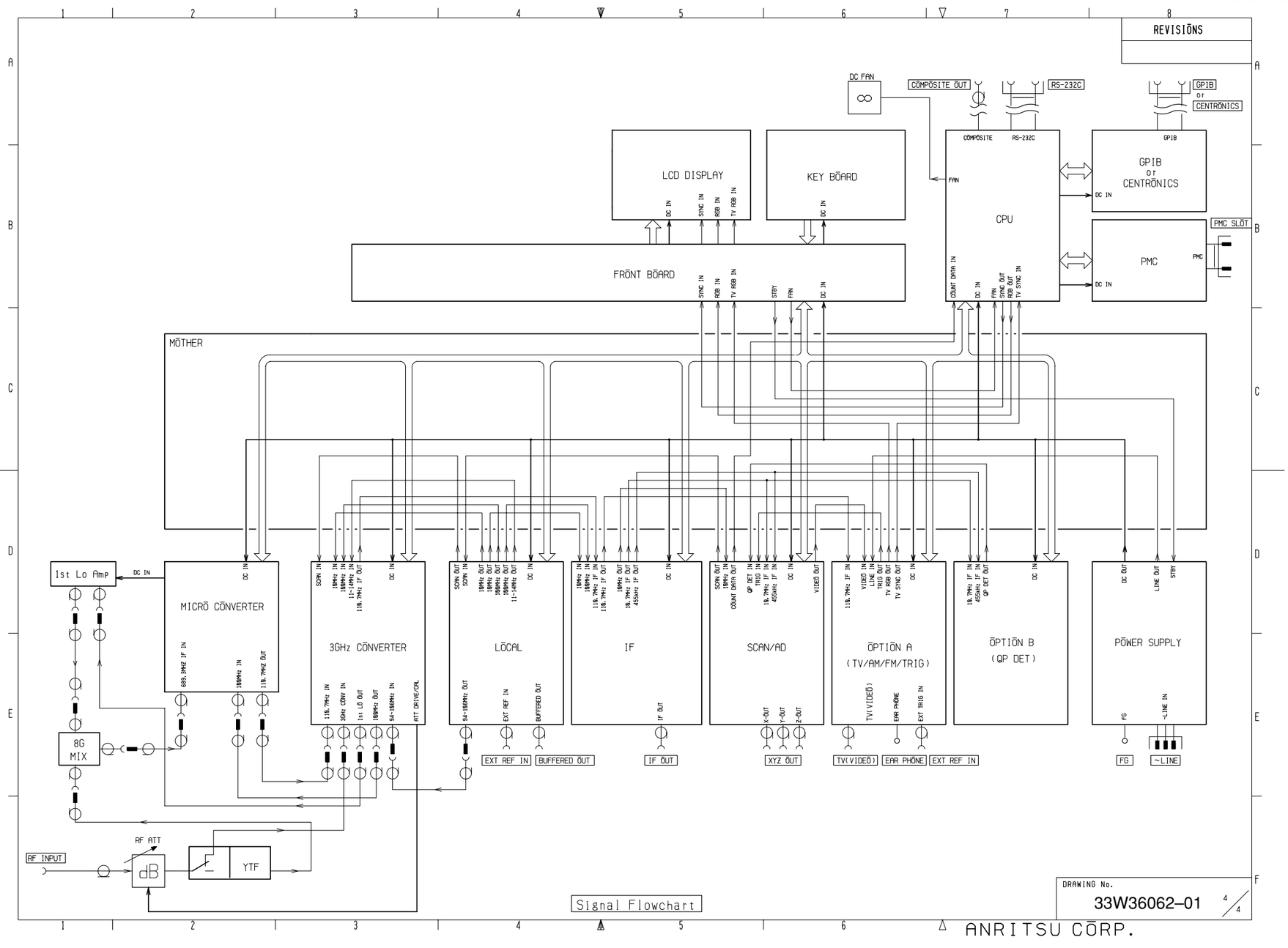


Fig. B-8 MS2653B/2663B Block Diagram (4/4)

APPENDIX B

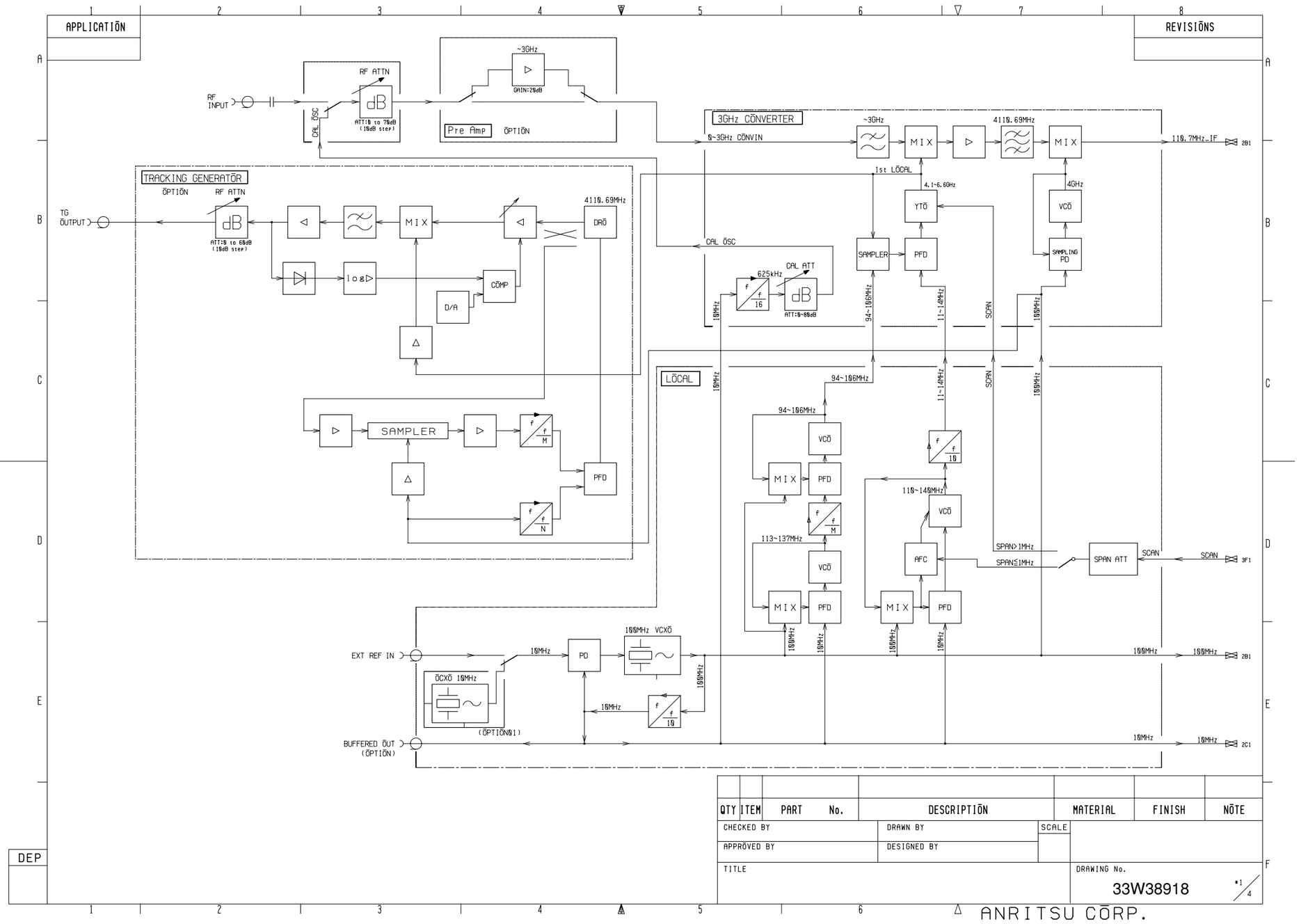


Fig. B-9 MS2661C Block Diagram (1/4)

APPENDIX B

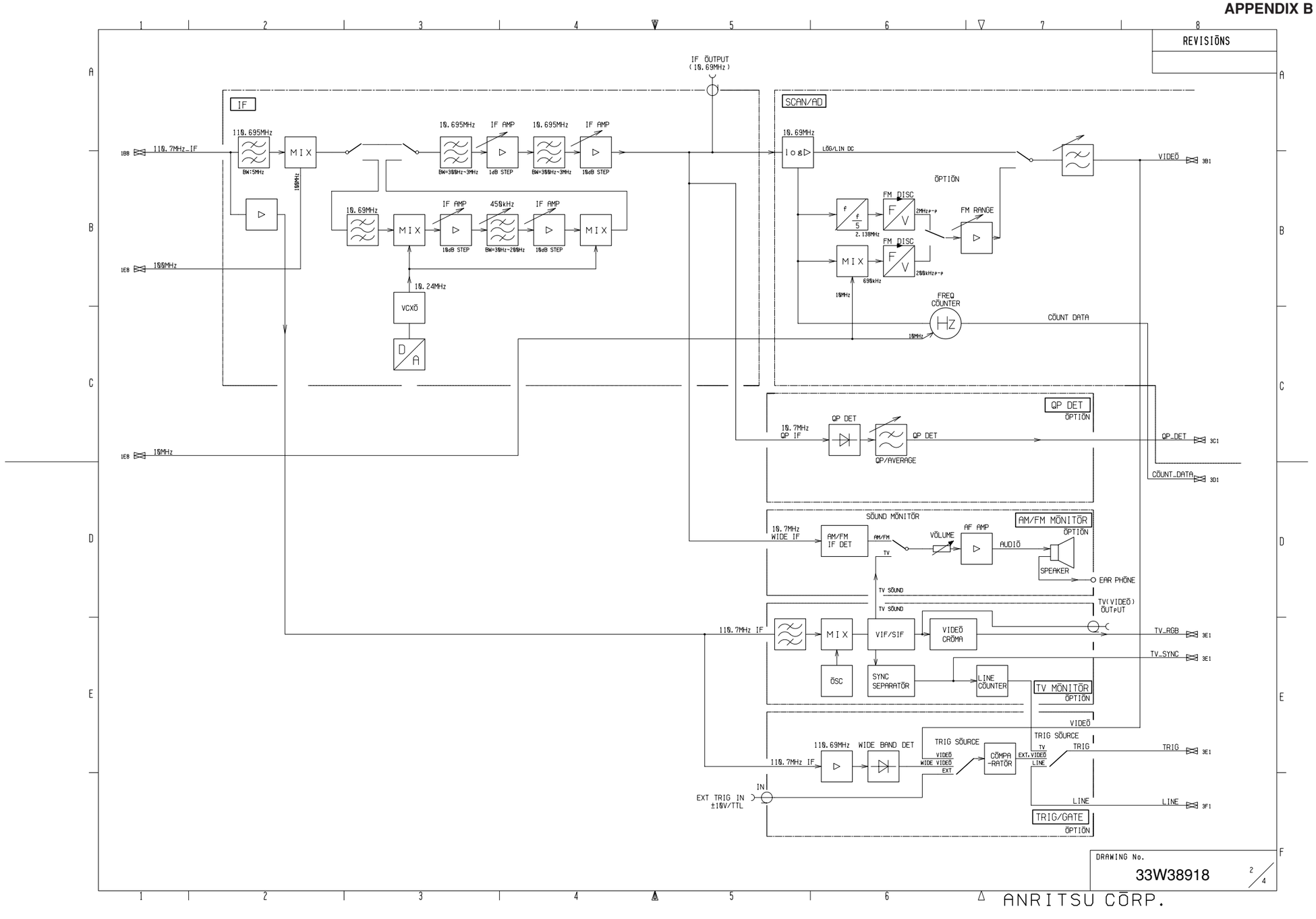


Fig. B-10 MS2661C Block Diagram (2/4)

APPENDIX B

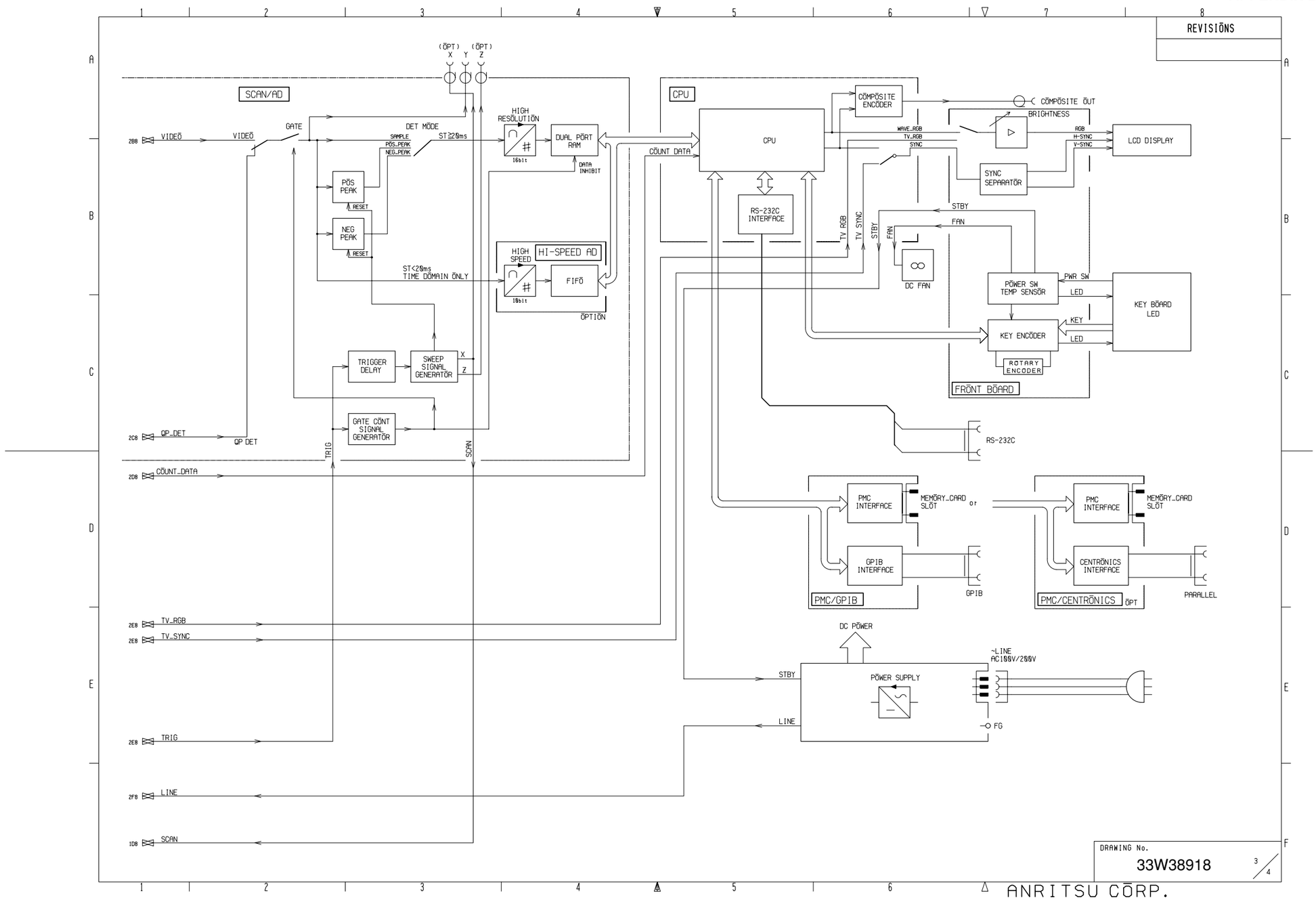


Fig. B-11 MS2661C Block Diagram (3/4)

APPENDIX B

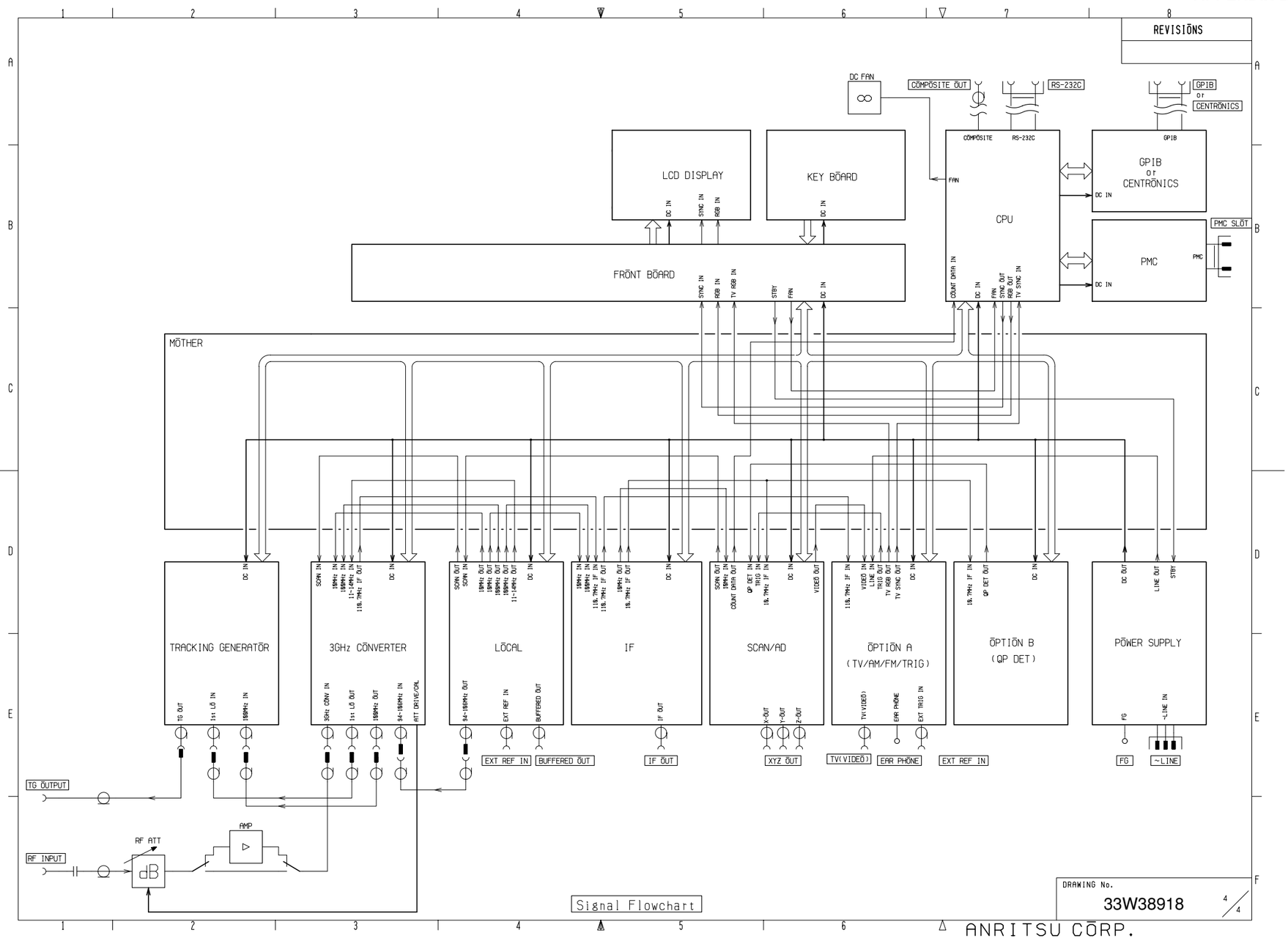


Fig. B-12 MS2661C Block Diagram (4/4)

APPENDIX B

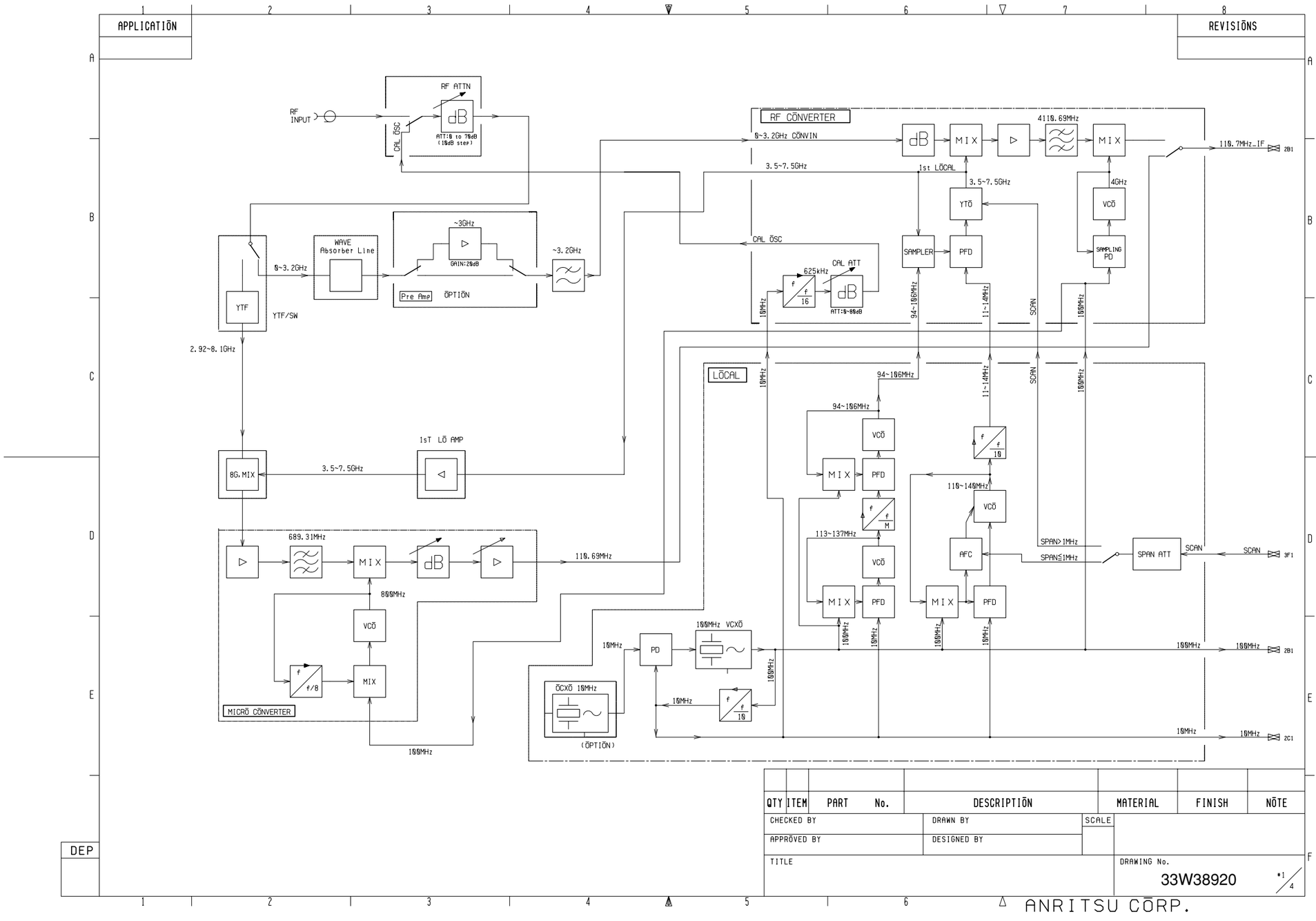


Fig. B-13 MS2663C Block Diagram (1/4)

APPENDIX B

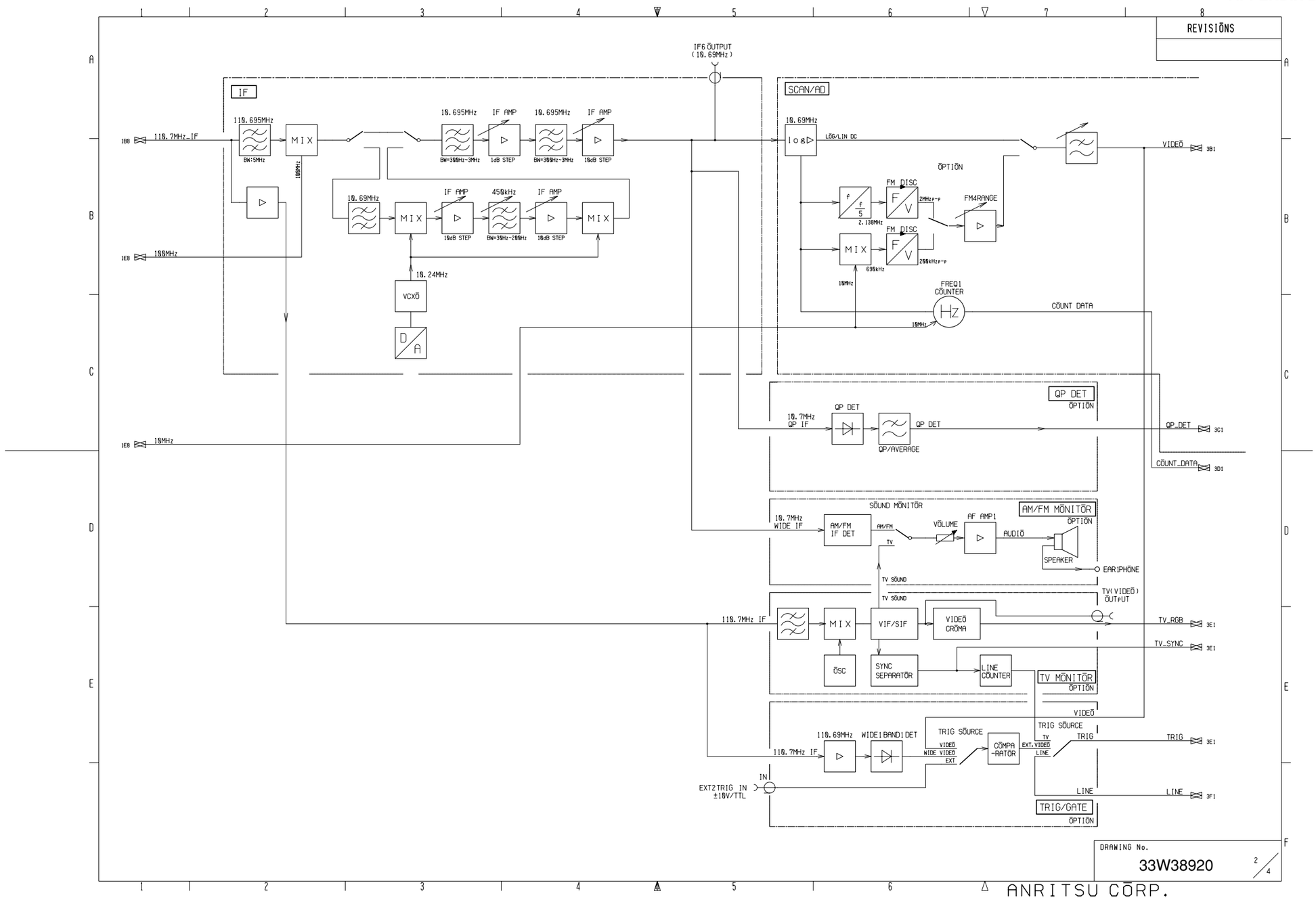


Fig. B-14 MS2663C Block Diagram (2/4)

APPENDIX B

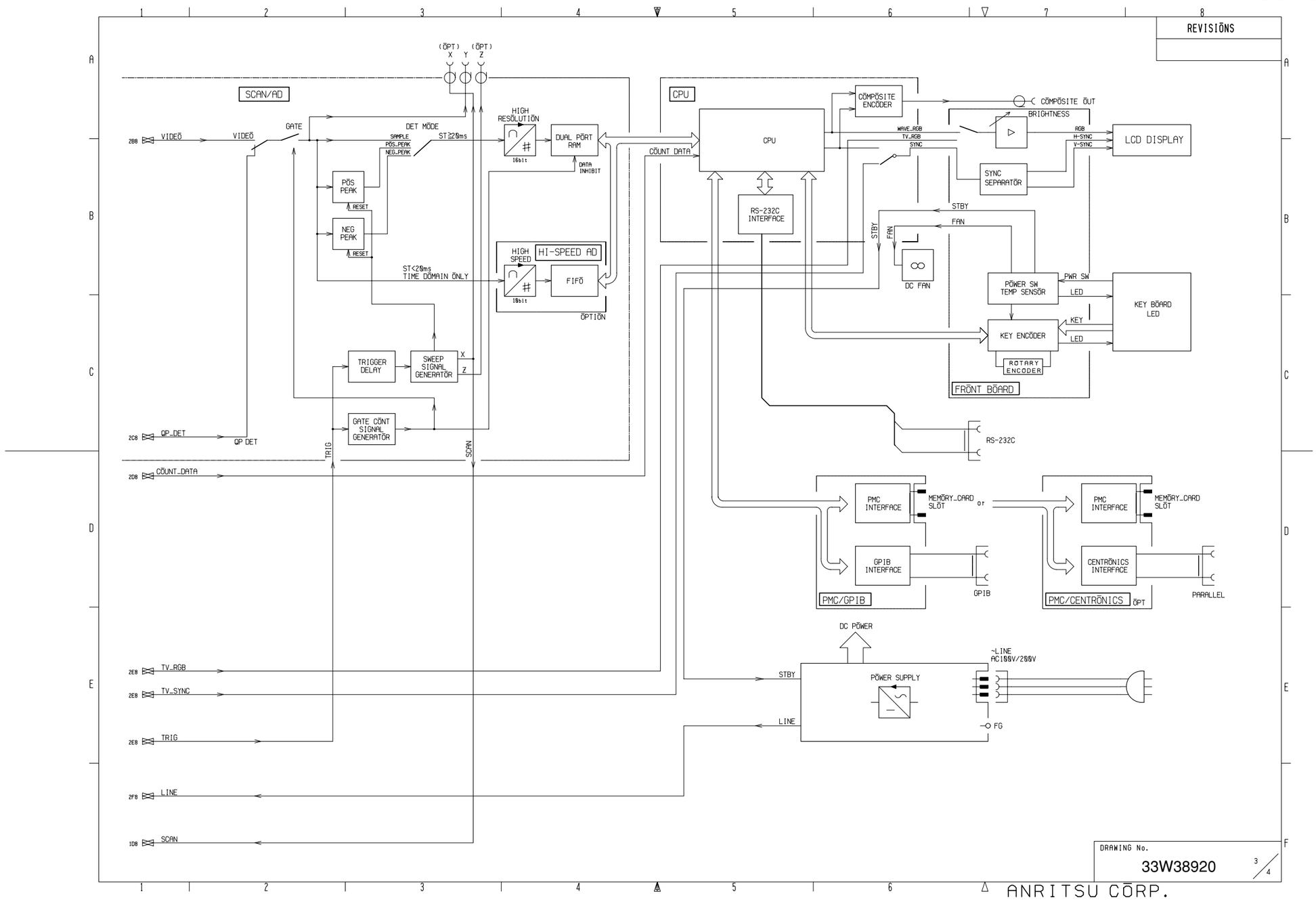


Fig. B-15 MS2663C Block Diagram (3/4)

APPENDIX B

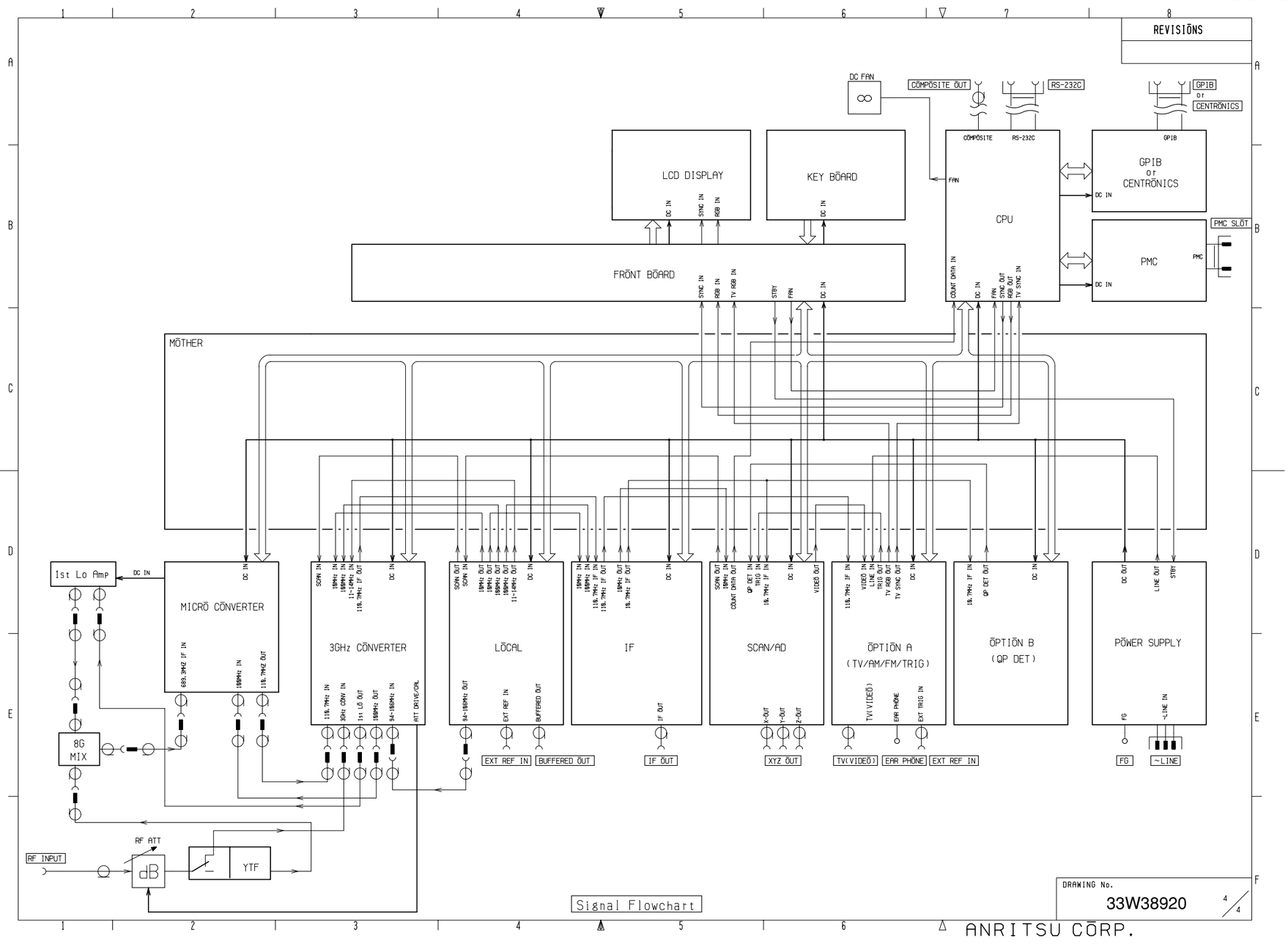


Fig. B-16 MS2663C Block Diagram (4/4)

APPENDIX B

APPENDIX C
PERFORMANCE TEST RECORD

Performance Test Record

(1/13)

NO._____
DATE_____

MODEL _____
SERIAL NO. _____
OPTIONS _____

Date _____
Tested by_____
Ambient temparature_____°C
Relative humidity_____%
Perwer mains line voltage (nominal) _____Vac
Powermains line frquency (nominal) _____Hz

Test Equipment used

Descriptions	MODEL NO.	Cal Date
Synthesized signal generator		
Synthesized Sweeper		
Attenuator		
Power meter		
Power senser		
Power senser		
50Ω Termination		
Low pass filter		
Frequency counter		
Frequency standard		

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Reference oscillator stability

- **Frequency stability (aging rate)**

Description	Min.	Result	Max.
Frequency stability/day	-2×10^{-8}		$+2\times10^{-8}$

- **Temparature stability**

Description	Min.	Result	Max.
Temparature stability	-5×10^{-8}		$+5\times10^{-8}$

Frequency readout accuracy

- **MS2651B/2661B/2661C**

Signal generator	Center frequency	Span frequency	Readout frequency		
			Min.	Maker value	Max.
500MHz	500MHz	10kHz 200kHz 100MHz	499.999 66MHz 499.995 2MHz 497.6MHz		500.000 34MHz 500.004 8MHz 502.4MHz

- **MS2653B/2663B/2663C**

Signal generator	Center frequency	Span frequency	Band	Readout frequency		
				Min.	Maker value	Max.
500MHz	500MHz	10kHz 200kHz 100MHz	0	499.999 66MHz 499.995 2MHz 497.6MHz		500.000 34MHz 500.004 8MHz 502.4MHz
5GHz	5GHz	10kHz 200kHz 100MHz	1–	4.999 999 55GHz 4.999 994 8GHz 4.997 6GHz		5.000 000 45GHz 5.000 005 2GHz 5.002 4GHz
7.5GHz	7.5GHz	10kHz 200kHz 100MHz	1+	7.499 999 50GHz 7.499 994 8GHz 7.497 6GHz		7.500 000 50GHz 7.500 005 2GHz 7.502 4GHz

(3/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Frequency span readout

• **MS2651B/2661B/2661C**

SPA		Signal generator		Result		
Center frequency	Span frequency	f_1 (GHz)	f_2 (GHz)	Min.	$\frac{f_2 - f_1}{0.8}$	Max.
1GHz	20kHz	0.999 992GHz	1.000 008GHz	19.5kHz		20.5kHz
	200kHz	0.999 92GHz	1.000 08GHz	195kHz		205kHz
	2MHz	0.999 2GHz	1.000 8GHz	1.95MHz		2.05MHz
	10MHz	0.996GHz	1.004GHz	9.75MHz		10.25MHz
	100MHz	0.96GHz	1.04GHz	97.5MHz		102.5MHz
	2GHz	0.2GHz	1.8GHz	1.95GHz		2.05GHz

• MS2653B/2663B/2661C

SPA		Signal generator		Result		
Center frequency	Span frequency	f_1 (GHz)	f_2 (GHz)	Min.	$\frac{f_2 - f_1}{0.8}$	Max.
1GHz	20kHz	0.999 992GHz	1.000 008GHz	19.5kHz		20.5kHz
	200kHz	0.999 92GHz	1.000 08GHz	195kHz		205kHz
	2MHz	0.999 2GHz	1.000 8GHz	1.95MHz		2.05MHz
	10MHz	0.996GHz	1.004GHz	9.75MHz		10.25MHz
	100MHz	0.96GHz	1.04GHz	97.5MHz		102.5MHz
	2GHz	0.2GHz	1.8GHz	1.95GHz		2.05GHz
4.05GHz	100MHz	4.21GHz	4.29GHz	97.5MHz		102.5MHz
	1GHz	3.85GHz	4.65GHz	0.975GHz		1.025GHz
	8.1GHz	0.81GHz	7.29GHz	7.8975GHz		8.3025GHz

(4/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Resolution bandwidth accuracy

- **MS2651B/2661B/2653B/2663B**

Resolution Bandwidth	Span	Bandwidth (3dB)
5MHz	10MHz	
1MHz	5MHz	
300kHz	500kHz	
100kHz	200kHz	
30kHz	50kHz	
10kHz	20kHz	
3kHz	5kHz	
1kHz	2kHz	

- **MS2661C/2663C**

Resolution Bandwidth	Span	Bandwidth (3dB)	Specification
3MHz	10MHz		±30%
1MHz	5MHz		±20%
300kHz	500kHz		±20%
100kHz	200kHz		±20%
30kHz	50kHz		±20%
10kHz	20kHz		±20%
3kHz	5kHz		±20%
1kHz	2kHz		±20%

(5/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Resolution bandwidth selectivity

- **MS2651B/2661B/2653B/2663B**

Resolution Bandwidth	Frequency Span	Video Bandwidth	60dB BW	3dB BW	60dB BW/ 3dB BW
5MHz	100MHz	100Hz			≤15
1MHz	20MHz	100Hz			≤15
300kHz	10MHz	100Hz			≤10
100kHz	5MHz	100Hz			≤10
30kHz	1MHz	100Hz			≤10
10kHz	200kHz	100Hz			≤10
3kHz	100kHz	100Hz			≤10
1kHz	50kHz	100Hz			≤10

- **MS2661C/2663C**

Resolution Bandwidth	Frequency Span	Video Bandwidth	60dB BW	3dB BW	60dB BW/ 3dB BW
3MHz	100MHz	100Hz			≤15
1MHz	20MHz	100Hz			≤15
300kHz	10MHz	100Hz			≤15
100kHz	5MHz	100Hz			≤15
30kHz	1MHz	100Hz			≤15
10kHz	200kHz	100Hz			≤15
3kHz	100kHz	100Hz			≤15
1kHz	50kHz	100Hz			≤15

Sideband phase noise

- **MS2651B/2653B**

Center frequency	Results	Specification
1GHz		≤–90dBc/Hz

- **MS2661B/2663B/2661C/2663C**

Center frequency	Results	Specification
1GHz		≤–100dBc/Hz

(6/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Frequency measurement accuracy

Signal generator	Measurement Resolution	Min.	Reaults	Max.
500MHz	1Hz	499.999 989MHZ	_____	500.000 011MHz
500MHz	10Hz	499.999 98MHZ	_____	500.000 02MHz
500MHz	100Hz	499.999 9MHZ	_____	500.000 1MHz
500MHz	1kHz	499.999MHZ	_____	500.001MHz

Amplitude display accuracy

- **Log scale Fidelity**

ATT setting (dB)	A	B	Error (dB)=A+B	Spec
	ATT Calibration factor (dB)	Δ maker readout (dB)		
0	0 (reference)		0 (reference)	0 (reference)
5	_____	_____	_____	±0.4dB
15	_____	_____	_____	±0.4dB
20	_____	_____	_____	±0.4dB
25	_____	_____	_____	±0.4dB
30	_____	_____	_____	±1.0dB
35	_____	_____	_____	±1.0dB
40	_____	_____	_____	±1.0dB
45	_____	_____	_____	±1.0dB
50	_____	_____	_____	±1.0dB
55	_____	_____	_____	±1.0dB
60	_____	_____	_____	±1.0dB
65	_____	_____	_____	±1.0dB
70	_____	_____	_____	±1.0dB
75	_____	_____	_____	±1.5dB
80	_____	_____	_____	±1.5dB
85	_____	_____	_____	±1.5dB
90	_____	_____	_____	±2.5dB

(7/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Frequency response

- **MS2651B/2661B/2661C (RF ATT: 10dB, 18° to 28°C)**

Signal generator	Calibration level (dBm)	Marker level (dB)	Deviation	Spec.
100MHz	0 (reference)	0 (reference)	0 (reference)	0 (reference)
200MHz	_____	_____	_____	±0.5dB
500MHz	_____	_____	_____	±0.5dB
1GHz	_____	_____	_____	±0.5dB
1.5GHz	_____	_____	_____	±0.5dB
2GHz	_____	_____	_____	±0.5dB

- **MS2653B/2663B/2663C (RF ATT: 10dB, 18° to 28°C)**

Signal generator	Band (mixing order)	Calibration level (dBm)	Marker level (dB)	Deviation	Spec.
100MHz	0 (1)	0 (reference)	0 (reference)	0 (reference)	0 (reference)
200MHz	0 (1)	_____	_____	_____	±0.5dB
500MHz	0 (1)	_____	_____	_____	±0.5dB
1GHz	0 (1)	_____	_____	_____	±0.5dB
1.5GHz	0 (1)	_____	_____	_____	±0.5dB
2.0GHz	0 (1)	_____	_____	_____	±0.5dB
3.0GHz	0 (1)	_____	_____	_____	±0.5dB
3.1GHz	1^{-}(1)	_____	_____	_____	±1.5dB
4GHz	1^{-}(1)	_____	_____	_____	±1.5dB
5GHz	1^{-}(1)	_____	_____	_____	±1.5dB
6GHz	1^{-}(1)	_____	_____	_____	±1.5dB
6.5GHz	1^{-}(1)	_____	_____	_____	±1.5dB
6.5GHz	1^{+}(1)	_____	_____	_____	±1.5dB
7GHz	1^{+}(1)	_____	_____	_____	±1.5dB
7.5GHz	1^{+}(1)	_____	_____	_____	±1.5dB
8GHz	1^{+}(1)	_____	_____	_____	±1.5dB

(8/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Reference level accuracy

Reference Level setting	Marker readout	Correction factor of ATT	Error *1	Spec.
0dBm				±0.4dB
–10dBm				±0.4dB
–20dBm				±0.4dB
–30dBm				±0.4dB
–40dBm				±0.4dB
–50dBm				±0.75dB
–60dBm				±0.75dB
–70dBm				±1.5dB
–80dBm				±1.5dB

*1:Caliculate the “Error” from the following equation

Error=Marker readout-Reference Level set value-corection factor of ATT

(9/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Average noise level

- **MS2651B**

MS2651B setting		Average noise level	
START FREQ	STOP FREQ	Maker readout	Spec.
1MHz	1GHz		–110dBm
1GHz	2GHz		–109 to –108dBm

- **MS2661B/2661C**

MS2661 setting		Average noise level	
START FREQ	STOP FREQ	Maker readout	Spec.
1MHz	1GHz		–115dBm
1GHz	2GHz		–114 to –113dBm

- **MS2653B**

MS2653B setting		Average noise level	
START FREQ	STOP FREQ	Maker readout	Spec.
1MHz	1GHz		–110dBm
1GHz	2GHz		–109 to –108dBm
4.0GHz	6.0GHz		–108 to –107dBm
7.0GHz	8.0GHz		–106.5 to –106dBm

- **MS2663B/2663C**

MS2663 setting		Average noise level	
START FREQ	STOP FREQ	Maker readout	Spec.
1MHz	1GHz		–115dBm
1GHz	2GHz		–114 to –113dBm
4.0GHz	6.0GHz		–113 to –112dBm
7.0GHz	8.0GHz		–115.5 to –111dBm

(10/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Second harmonic distortion

Signal generator	Second harmonic distortion (dB)
10.1MHz	
100.1MHz	
500.1MHz	
800.1MHz	
1000.1MHz	
1499.9MHz	
2000.1MHz	
2500.1MHz	

(11/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Resolution bandwidth switching error

- **MS2651B/2661B/2653B/2663B**

MS2650/2660 series setting		Δ marker readout	Specification
RBW	SPAN		
1kHz	5kHz		±0.3dB
3kHz	15kHz	0.0dB	Reference
10kHz	50kHz		±0.3dB
30kHz	150kHz		±0.3dB
100kHz	500kHz		±0.3dB
300kHz	1.5MHz		±0.3dB
1MHz	5MHz		±0.3dB
5MHz	10MHz		±0.4dB

- **MS2661C/2663C**

MS2650/2660 series setting		Δ marker readout	Specification
RBW	SPAN		
1kHz	5kHz		±0.3dB
3kHz	15kHz	0.0dB	Reference
10kHz	50kHz		±0.3dB
30kHz	150kHz		±0.3dB
100kHz	500kHz		±0.3dB
300kHz	1.5MHz		±0.3dB
1MHz	5MHz		±0.3dB
3MHz	10MHz		±0.4dB

(12/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by _____

Input attenuator swithing error

MS2650/MS2660 Series setting

Reference Level	ATT	Attenuator setting	Correction factor of attenuator	Marker readout	Error	Deviation	Spec.
–10dBm	50dB	0dB	dB	dBm	dB	dB	±0.3dB
–20dBm	40dB	10dB	dB	dBm	dB	dB	±0.3dB
–30dBm	30dB	20dB	dB	dBm	dB	dB	±0.3dB
–40dBm	20dB	30dB	dB	dBm	dB	dB	±0.3dB
–50dBm	10dB	40dB	dB	dBm	dB	0dB (reference)	0dB (reference)
–60dBm	0dB	50dB	dB	dBm	dB	dB	±0.3dB

Sweep time and Time span accuracy

- **Sweep time**

MS2650/2660 series setting	Signal generator		
SWEEP TIME	AM Modulation frequency	SWT TIME (measured)	Specification min/max
50msec	400Hz	sec	38.25msec/51.75msec
200msec	100Hz	sec	153msec/207msec
2sec	10Hz	sec	1.53sec/2.07sec
20sec	1Hz	sec	15.3sec/20.7sec
200sec	0.1Hz	sec	99sec/261sec

- **Time span accuracy**

MS2650/2660 series setting	Signal generator		
Time span	AM Modulation frequency	Time span (measured)	Specification min/max
20msec	1kHz	sec	17.82msec/18.18msec
200msec	100Hz	sec	178.2msec/181.8msec
2sec	10Hz	sec	1.782sec/1.818sec
20sec	1Hz	sec	17.82sec/18.18sec
200sec	0.1Hz	sec	178.2sec/181.8sec

(13/13)

MODEL NAME _____ DATE_____

SERIAL NO._____

Tested by_____

Tracking generator output level accuracy

	Frequency (Hz)							
Output level (dBm)	100k	1M	10M	50M	100M	1G	2G	3G
0								
–5								
–10								
–20								
–30								
–40								
–50								