Network Analyzers

For Evaluation and Inspection of Digital Communication Devices

R3766H/3767H Series

■ **Measurement frequency range**
40MHz to 8.0GHz R3766H/3767H Series
■ **Three models available for all types of applications**
Type A: Basic Model
Type B: Built In SWR Bridge Model
Type C: Built In S-parameter Test Set Model
■ **High sweep speed**
0.15ms/point(with normalized calibration)
0.25ms/point(with 2-port full calibration)
■ **4-channel, 8-trace high-performance display**
■ **100 dB dynamic range measurement**

(Photo is R3767CH)

R3766H/3767H series
Network Analyzers

Recent years have seen a great progress in digital information and communication equipment such as PDC/PHS digital mobile radio equipment and communication equipment for ISDN. Accordingly, requirements for dielectric filters, SAW filters, layer-built filters, antennas, isolators, power amplifiers, and other high-frequency electronic devices used in communication equipment are becoming more severe and stricter: higher frequency, smaller sizes, lower power consumption, and so on. The R3766H/3767H series is a vector network analyzers which can measure the amplitude, phase, group delay time and impedance of high-frequency electronic devices with high precision and high speed.
The series comes in three different models with measurement frequency ranges: 40MHz to 8.0GHz.
In addition, the use of newly developed high-speed signal processing architecture realizes high speed measurement of 0.15ms/point (at normalized calibration) or 0.25ms/point (at 2-port full calibration) with 10 kHz resolution bandwidth.
One of the major advantages of the series is that it helps you choose the model which best suits your application.
The R3766H/3767H using a 7.8-inch large TFT color LCD is suitable both for line and engineering use. Each series comes in three different models including type A (basic model), type B (model with a built-in SWR bridge) and type C (model with a built-in S-parameter test set).

■ Programmed Sweep Realizes High-Speed and High-Resolution Measurement

The R3764H/3765H/3766H/3767H series is provided with the programmed sweep function as standard which makes it possible to vary output power and resolution bandwidth (RBW) during sweep.
In evaluation of filter characteristics for instance, measurement with high speed, high accuracy and high reproducibility can be realized by varying resolution bandwidth and output power in pass or stop band.

■ Limit Line Function for Adjustment and Test

The limit line function performs PASS/FAIL test based on the judgment value set by the limit line editor and then displays the test result. In addition, the color of limit lines
and waveform data can be specified for each judgment area, allowing the user to make PASS/FAIL judgment at a glance during judgement on the screen.
In POLAR and Smith chart measurement, the series has the ability to make limit judgement both for amplitude/phase adjustment for specified frequency ranges and automatic test result judgement.

Improved H Series Performance Items

- Manually selectable display colors (256 colors)
- Expanded BASIC programming memory capacity (1MB)
- Expanded save register capacity (2MB)
- Improved BASIC processing speed
- CDMA IF filter analysis function integrated
- New 3-port device calibration function

For Evaluation and Inspection of Digital Communication Devices

R3766H/3767H Series

■ Series for system use

32-line-by-8-character
fluorescent
character display

R3766AH/BH/CH
(8.0GHz)

■ Series for stand-alone use

7.8-inch
TFT color LCD

R3767AH/BH/CH
(8.0GHz)

Product type	Advantages	Application					Representative process lines
		Unipolar BPF	Multipolar BPF	Duplexer	Power amplifier	2-piece parallel measurement	
A type General-purpose model R3766AH, R3767AH	Test set connectable			○	○	○	Preprocess: Dielectric filter Duplexer SAW filter, etc. Inspection line: Power amplifier
B type IZI measurement low-cost model R3766BH, R3767BH	Bridge integrated Transmission/reflection simultaneous measurement	○					Intermediate process: Dielectric filter Duplexer Mobile telephone antenna Inspection line: Mobile telephone antenna
C type S parameter full measurement model R3766CH, R3767CH	S parameter test set integrated Forward/reverse direction measurement		○				Inspection line: Dielectric filter SAW filter, cable. Circulator Isolator Technical development

For R3766H/3767H, 3 types are prepared so that you can select the one which best matches your application.

A type

Basic Model
R3766AH/3767AH

With a built-in signal separator and two inputs, type A can perform simultaneous measurement for two devices. By connecting the S-parameter test set, it can measure 2-port devices; with the optional duplexer test set, it can measure a duplexer with three ports (ANT, RX, and TX terminals) which is used at the front section of mobile radio equipment. When the optional power amplifier test set is connected and a voltage & current generator (VIG) is used together, it can perform measurement on the power amplifier in portable phones. (In this case, however, extended network analyzer functions must be installed.)

B type

Built-In SWR Bridge Model for [Z] measurement
R3766BH/3767BH

Type B incorporates a power splitter and a SWR bridge, allowing transmission and reflection characteristics to be measured efficiently at the same time. In addition, by executing 1-port calibration, measurement with higher accuracy is possible.

C type

Built-In S-Parameter Test Set Model
R3766CH/3767CH

Type C incorporates the S-parameter test set mounting two SWR bridges, a power splitter and a semiconductor switch for forward/reverse switching. It can measure forward characteristics (S11 and S21) and reverse characteristics (S22 and S12) with high accuracy in auto-reversing mode.
By connecting the optional duplexer test adapter, it can measure a duplexer with three ports.

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R3766H/3767H Series

■ High Throughput Cuts Test Cost

In production lines of electronic devices, reduction of test cost is an essential issue. The R3766H/3767H series realizes the highest throughput in its class.

■ High throughput with high speed sweep

0.15ms/point
(with 10kHz resolution bandwidth and normalized calculation)
0.25ms/point
(with 10kHz resolution bandwidth and 2-port full calculation)

■ Shortens data transfer time to 1/4

In highly automated production lines of electronic parts, the time necessary to transmit to/receive from external computers affects the overall system thoughput. The R3766H/3767H series uses direct memory access (DMA) together with dual port memory, reducing the data transfer time to 1/4 (in in-house comparison).
For example, it takes only 60 ms (typ.) to perform data transmission for 1201 points, i.e. a transmission speed of 50 µs or less per point is realized.

■ Reduces instrument setup time to 1/2

In parts test, a variety of items are tested and therefore the setup time is essential.
With the R3766H/3767H series, software algorithm is remarkably improved and the setup time is reduced to 1/2 (in in-house comparison). For example, the sum of the recall time and single sweep time at 2-port full calibration (with 1kHz resolution) is only 1.5 seconds.

■ 100 dB Dynamic Range for Filter Test

For ripple evaluation in pass band and spurious check in stop band as is the case with dielectric filters, measurement with a wide dynamic range is crucial.
The R3766H/3767H series realizes 100 dB dynamic range with 10 Hz resolution bandwidth, making it suitable for testing of high-attenuation devices used in base stations of portable phones.

■ CDMA IF Filter Analysis Function

The H series network analyzers can now accurately and efficiently measure the SAW filter characteristics of the CDMA system.

1. Gate function

This removes the effects of multiple reflections in the SAW device for measuring the characteristics of the SAW waves alone.

2. Phase linearity

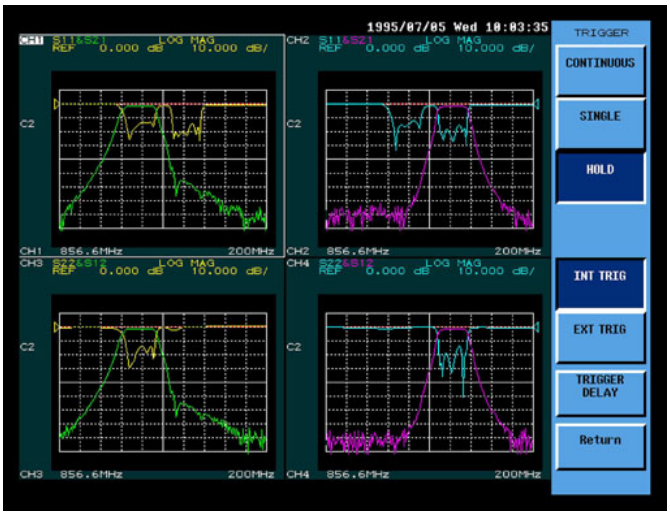
This implements real-time analysis of phase linearity. For instance, changes in phase linearity by gate on/off can be analyzed simultaneously on a multiple-window display.

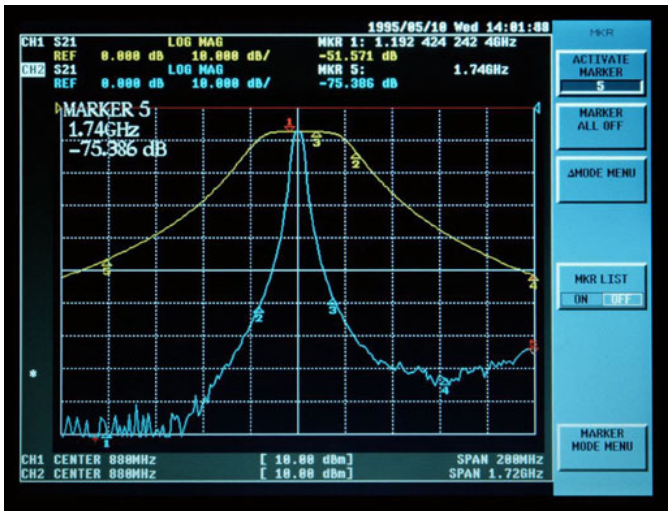
3. Time domain analysis (option)

The propagation characteristics of the SAW device can be analyzed on the time axis. The time and frequency axes can be displayed simultaneously also.

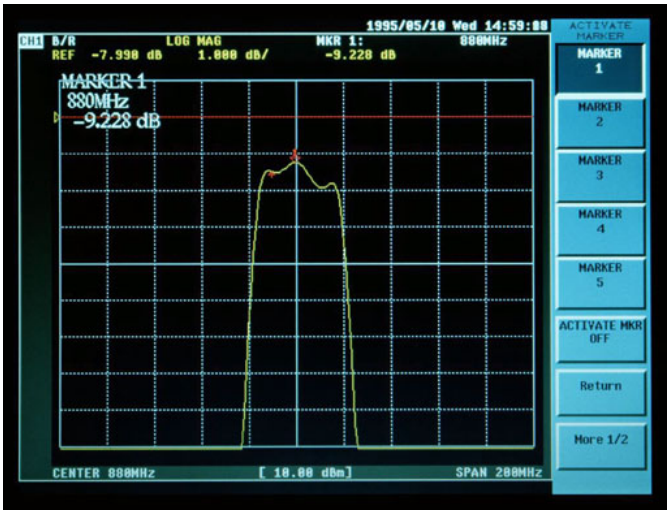
■ Powerful 4-Channel/8-Trace Function with Simultaneous Display

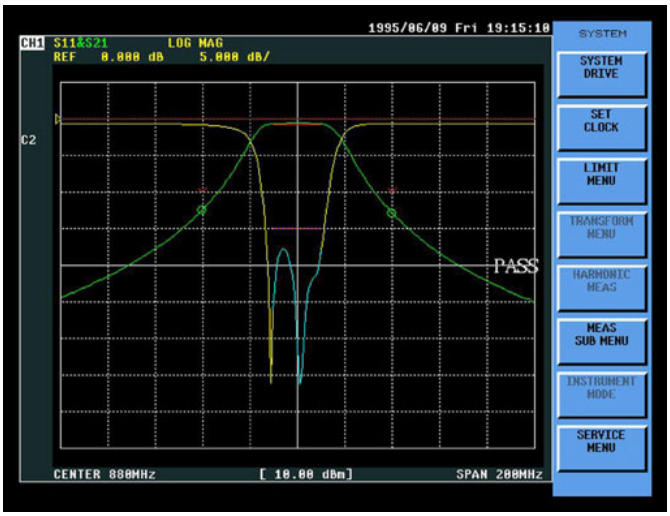
The R3767H series is provided with the 4-channel/8-trace function and simultaneous display is possible.
For example, when a 3-port test adapter is connected to the R3767CH, simultaneous and realtime measurement of Tx/Rx characteristics of the duplexer is possible.
Channels 1 and 3 measure four S-parameters of Tx and channels 2 and 4 measure those of Rx at the same time with a throughput of approx. 250 ms (with 201 points and 2-port full calibration). In addition, limit lines and multi maker function can be used for each of the four screens.

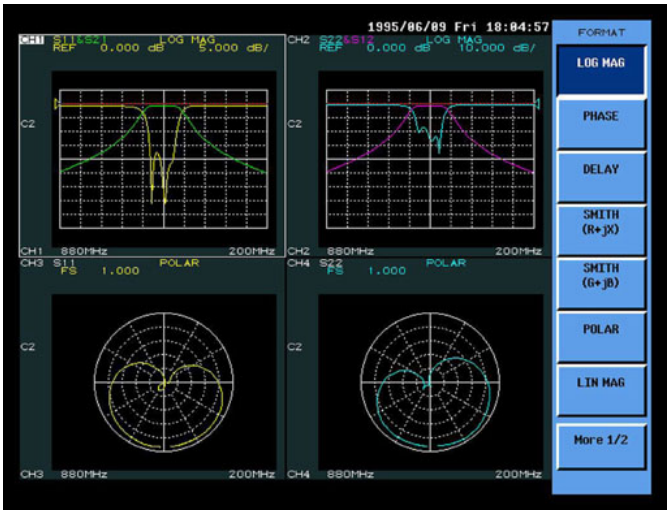




Dielectric Filter Measurement







■ For Preprocess

This processes dielectric material into original component and then adjusts the specified resonance frequency, using transmission/reflection method.
In this stage, a low-price network analyzer with high speed and automatic measurement function is required. The R3764AH/3764BH model is recommended which is for system use and of low-priced type.

■ For Intermediate Process

This process assembles adjusted original component of dielectric material, processes into the form of filters and then implements filter characteristics.
In general, there are two types of adjustment methods: single directional and bi-directional methods. Adjustment is made while monitoring frequency characteristics by means of display waveform.
In this stage, TFT color LCD with tilt mechanism and better working environment are required. For this purpose, it is necessary to reduce the depth of the work area by 10 cm. In addition, the limit line function is required to make PASS/FAIL test at a glance in realtime. The R3765BH/3765CH model with a built-in SWR bridge and S-parameter test set for stand-alone use is recommended.

■ For Test Process

This process performs total characteristics test of molded and completed filters including spurious measurement.
This process has been made automatic to some extent. However, waveform observation by the human eyes is required as the final check. Because the process requires a wide range of measurement including spurious measurement, the highest R3767CH model of 8 GHz stand-alone type is recommended.

Network Analyzers

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R3766H/3767H Series

Specifications

Measurement Functions

Sweep channel	2 channel (CH 1 and CH 2)		
Display channel	4 channel (CH 1, and CH 2 , CH 3 , and CH 4)		
Trace	2 traces/channel		
Display parameter	**TypeA**	**TypeB**	**TypeC**
	A/R, B/R	Transmission Reflection Transmission& reflection	S11, S21, S22, S12 S21&S11, S12&S22
Format			
Rectangular coordinates	Log/linear amplitude, phase, and group delay or real part + imaginary part of complex parameter |Z|, R, X (at measurement with impedance conversion) |Y|, G, B (at measurement with admittance conversion) Phase extension display function		
Smith chart (R3767H only)	Maker reading : Log/linear amplitude, phase, real part + imaginary part, R + jX, G + jB		
Polar coordinates (R3767H only)	Maker reading : Log/linear amplitude, phase, real part + imaginary part		

Receiver Characteristics

Resolution bandwidth	10 kHz to 10 Hz (in 1 or 3 steps)	
Amplitude characteristics		
Amplitude resolution	0.001 dB	
Dynamic accuracy	With respect to -20 dB below maximum input level of test port	
	0 to -10 dB	±0.3 dB (40 MHz ≤ f ≤ 3.8 GHz)
		±0.8 dB (3.8 MHz ≤ f ≤ 8.0 GHz)
	-10 to -20 dB	±0.05 dB (40 MHz ≤ f ≤ 3.8 GHz)
		±0.2 dB (3.8 MHz ≤ f ≤ 8.0 GHz)
	-20 to -50 dB	±0.05 dB
	-50 to -60 dB	±0.10 dB
	-60 to -70 dB	±0.15 dB
	-70 to -80 dB	±0.40 dB
	-80 to 90 dB	±1.00 dB
Frequency characteristics	1.0 dB (-10 dBm, 25°C ±5°C)	
Phase characteristics		
Measurement range	±180° (Display for ±180° or more is possible by means of display extension function)	
Phase resolution	0.01°	
Frequency characteristics	±5° (-10 dBm, 25°C ±5°C)	
Dynamic accuracy	With respect to -20 dB below maximum input level of test port	
	0 to -10 dB	±5.0°
	-10 to -20 dB	±0.3° (40 MHz ≤ f ≤ 3.8 GHz)
		±0.8° (3.8 GHz ≤ f ≤ 8.0 GHz)
	-20 to -50 dB	±0.3°
	-50 to 60 dB	±0.4° (40 MHz ≤ f ≤ 3.8 GHz)
		±0.8° (3.8 GHz ≤ f ≤ 8.0 GHz)
	-60 to -70 dB	±1.5°
	-70 to -80 dB	±4.0°
	-80 to 90 dB	±8.0°
Group delay time characteristics	Calculated by the following expression :	
Range	$r = \frac{\Delta \phi}{360 \times \Delta f}$; $\Delta \phi$: Phase, Δf : Aperture frequency (Hz)	
Measurement range	1 ps to 250 s	
Group delay time resolution	1 ps	
Aperture frequency	Is equal to Δf and can be set to $A \times 2\%$ to $A \times 100\%$ for frequency span, with a resolution of $A \times 2\%$.	
	$A = \frac{100}{\text{measurement points} - 1}$	
Accuracy	$\frac{\text{Phase accuracy}}{360 \times \text{Aperture frequency (Hz)}}$	

Signal Source Characteristics

Measurement frequency				
Range	40MHz to 8.0 GHz			
Set resolution	1 Hz			
Measurement resolution	±0.005 ppm			
Accuracy	±20 ppm (25°C ±5°C)			
Stability	±5 ppm (25°C ±5°C)			
Output level				
(40 MHz to 3.8 GHz)	**Type A**		**Type B**	**Type C**
Range	+17 to -8 dBm		+7 to -18 dBm	+10 to -15 dBm
Resolution	0.01 dB			
Accuracy	±0.5 dB (50 MHz, 0dBm, 25°C ±5°C)			
Linearity	25°C ±5°C			
	Type A	±0.4 dB	+12 to -3 dBm	With respect
		±0.7 dB	+17 to -8 dBm	to +7 dBm
	Type B	±0.4 dB	+2 to -13 dBm	With respect
		±0.7 dB	+7 to -18 dBm	to -3 dBm
	Type C	±0.4 dB	+5 to -10 dBm	With respect
		±0.7 dB	+10 to -15 dBm	to 0 dBm
Flatness	2.0 dBp-p (25°C ±5°C) For type C, at test port			
Output level	Output level fixed			
(3.8 GHz to 8GHz)	**Type A**		**Type B**	**Type C**
	-3 dBm or more		-16 dBm or more	-13 dBm or more
Output impedance	50 ohms			
Signal purity				
Harmonic distortion	≤20 dBc (at maximum output, 40 MHz to 3.8 GHz)			
Non-harmonic spurious	≤25 dBc (at maximum output, 40 MHz to 3.8 GHz)			
Phase noise	-85 dBc to 20 log (f/40 MHz) 10 kHz offset, 1 Hz bandwidth, at maximum output			
Sweep function				
Sweep parameter	Frequency, signal level			
Maximum sweep range				
Frequency	40 MHz to 8.0 GHz			
	Type A		**Type B**	**Type C**
Signal level	+17 dBm to -8 dBm		+7 dBm to -18 dBm	+10 dBm to -15 dBm
Sweep type	Linear/log frequency sweep, partial and arbitrary frequency sweep, level sweep and CW (single frequency) sweep			
Sweep time	0.15 ms/point (with normalized calibration) 0.25 ms/point (with 2-port full calibration) The minimum sweep time differs according to measurement format, type of error correction, sweep width per point, number of measurement points and IF bandwidth.			
Measurement point	3, 6, 11, 21, 51, 101, 201, 301, 401, 601, 801, or 1201 points			
Sweep trigger	Either "Continuous, hold, single sweep" or "External trigger" can be selected.			
Sweep mode				
Dual Sweep	Sweeps 2 channels (CH 1 and CH 2) with the same frequency range.			
Alternate sweep	Sweeps 2 channels (CH 1 and CH 2) with different sweep types and frequency ranges.			

R3766H/3767H Series

Test port Characteristics

Test port	25°C ±5°C		
Load matching	18 dB	40 MHz to 2.6 GHz	
	16 dB	2.6 GHz to 3.8 GHz	
	14 dB	3.8 GHz to 8.0 GHz	
Directivity	25°C ±5°C		
	30 dB	40 MHz to 2.6 GHz	
	26 dB	2.6 GHz to 3.8 GHz	
	22 dB	3.8 GHz to 8.0 GHz	
Crosstalk	**Types A and B**		**Type C**
	90 dB (40 MHz to 3.8 GHz)		90 dB (40 MHz to 2.6 GHz)
	80 dB (3.8 GHz to 5.0 GHz)		85 dB (2.6 GHz to 3.8 GHz)
	70 dB (5.0 GHz to 8.0 GHz)		70 dB (3.8 MHz to 5.8 GHz)
			60 dB (5.0 GHz to 8.0 GHz)
Connector	Type N (f), 50 ohms		
Noise level	With respect tp -20 dB below maximum input level of test board		
	-90 dB	3 kHz bandwidth	
	-100 dB	10 kHz bandwidth	
Maximum input level	**Types A and B**		**Type C**
	0 dBm		+15 dBm (40 MHz to 3.8 GHz)
			+12 dB (3.8 GHz to 8 GHz)
Input burning level	+21 dBm, ±30 VDC		
Maximum port bias	±30 VDC, 0.5 A (type C only)		

Error Correction Function

Normalized	Corrects frequency response (amplitude and phase) at transmission and reflection measurement.
1-port calibration	Corrects errors due to directivity, frequency response and source matching at reflection measurement. (For error correction, short/open/load calibration tools are required.)
2-port calibration	Corrects errors due to directivity, frequency response, source matching, load matching, and isolation at transmission and reflection measurement. (Type C only)
Data averaging	Averages data (vector value) for each sweep. Average factor can be set to 2 to 999.
Data smoothing	Obtains moving average between adjacent measurement points.
Electrical length correction	Adds measured phase and group delay time and equivalent electrical length or delay time.
Phase offset correction	Adds measured phase and a constant phase offset.
Correction by frequency interpolation	In frequency interpolation mode calibration, calculates error coefficient even when frequency and number of horizontal axis points are changed. Changes in frequency range (start/stop) are applied for the frequency range at initial calibration.

Connection of External Equipment

External display signal	15 pin D-SUB connector (VGA)
GPIB data output & remote control	Conforms to IEEE488.
Parallel I/O	TTL level, 8 bit output (2 ports) 4 bit input and output (2 ports)
Serial I/O	Conforms to RS232.
Keyboard I/O	Conforms to IBM PC-AT.
External reference frequency input	Input frequency range : 1, 2, 5, and 10 MHz ±10 ppm 0 dBm (50 ohms) or less
Probe power	±15 V ±0.5 V, 300mA

Display Unit

R3766H series	
Display unit	Fluorescent character display tube, green
Resolution	256 × 64 dots
Display mode	Character display, 32 lines × 8 characters
R3767H series	
Display unit	7.8 inch TFT color LCD
Resolution	640 × 480 dots
Display mode	Log/linear Cartesian coordinate, polar coordinate and Smith chart (impedance/admittance display)
Display format	Single channel 2 channels (Overlapped display, separated display) 4 channels (Separated display)
Measurement condition display	Start/stop, center/span, scale/DIV reference level, marker value, soft key functions, warning messages
Reference line position	Top (100%) to bottom (0%) of vertical-axis memory
Auto scale	Sets reference value and scale so that measured trace be displayed in the best form.
Brightness	Backlight can be turned ON or OFF.

Marker Function (R3767H only)

Marker display	Marker reading can be converted into display value corresponding to each measurement format.
Multi marker	10 markers can be set independently for each channel.
Delta marker	Each of 10 delta markers can be specified as reference marker and delta value between markers can be measured.
Marker couple	Markers of each channel can be set in coupled or independent manner.
Analysis of specified section	Marker search for section specified with Δ marker can be performed.
MRK search	MAX search, MIN search, and NEXT search
Marker tracking	Search operation for each sweep.
Target search	Calculates bandwidth, center frequency and Q for -X dB point. Frequency for phase 0° and frequency width of ±X° can be searched for.
MRK→	MRK→ reference value, MRK → START, MRK→ STOP, MRK→ CENTER
Limit line function	

Programming Function

BASIC controller function	The R3766H/3767H series and any other measuring instruments with GPIB interface can be controlled by means of standard controller function.
Built-in functions	High-speed analysis of measurement data is possible using built-in functions.
FDD function	Conforms to MS-DOS format Accommodates 3 modes (DD 720 kB, HD 1.2 MB/1.4 MB)

General Specifications

Operating environment	
When FDD is used	Temperature range : +5 to +40°C Humidity range : 80% or less (without condensation)
When FDD is not used	Temperature range : 0 to +50°C Humidity range : 80% or less (without condensation)
Storage environment	Storage temperature range : -20 to +60°C
Power voltage	100 to 120 VAC, 220 to 240 VAC, 48 to 66 Hz Automatic switching between 100 VAC and 200 VAC lines
Power consumption	300 VA or less
Dimensions	Approx. 424 (width) × 220 (height) × 400 (depth) mm
Weight	16 kg maximum (R3767H series)