

Table 7-1. Specifications (1 of 15)

These specifications describe the instrument's warranted performance over the temperature range of 0 to 55 °C (except where noted). The supplemental characteristics are intended to provide information useful in applying the instrument, these parameters are non-warranted performance parameters. These are denoted as "typical", "nominal", or "approximate".

--- GENERAL ---

OPERATING ENVIRONMENT:	Temperature: 0 °C to 55 °C Humidity: ≤95% RH (at 40 °C)
STORAGE TEMPERATURE:	-40 °C to 70 °C
SAFETY:	Based on IEC-348, ANSI-C-39.5
EMI:	Based on FTZ-526/527
POWER REQUIREMENTS:	100, 120, 220 V ±10%, 240 V -10% +5%, 48 Hz to 66 Hz, 500 VA (max)
DIMENSIONS:	Approximately 425(W) × 375(H) × 620(D) (mm)
WEIGHT:	Approximately 41 kg
EXTERNAL TRIGGER:	Rear Panel BNC(f), TTL level
USER PROGRAM TRIGGER:	Rear Panel BNC(f), TTL level
EXTERNAL STANDARD FREQUENCY INPUT (EXT REFERENCE connector):	
Frequency:	10/N MHz, ≤10 ppm (N is integer from 1 to 10)
Level:	-5 to +5 dBm (Typical)
Input Impedance:	Approximately 50Ω
Connector:	BNC(f)
STANDARD FREQUENCY OUTPUT:	
10 MHz OUTPUT connector:	
Frequency:	10 MHz, ±20 ppm at 23 ±5 °C
Level:	Typical 0 dBm
Connector:	BNC(f)
REFERENCE OVEN connector: (Option 001 only)	
Frequency:	10 MHz, ±1 ppm at 23 ±5 °C
Level:	Typical 2 dBm
Connector:	BNC(f)
8 BIT INPUT/OUTPUT:	D-SUB connector (25 pin), TTL level

Table 7-1. Specifications (2 of 15)

--- BASIC SPECIFICATIONS ---

NETWORK MEASUREMENT

SOURCE:

Frequency:

- Range: 10 Hz to 500 MHz
- Resolution: 1 mHz
- Accuracy: ± 20 ppm (23 ± 5 °C)
 ± 1 ppm (23 ± 5 °C; with Option 001)
- Stability: $\pm 5 \times 10^{-6}$ /day (23 ± 5 °C; Typical)
 $\pm 1 \times 10^{-8}$ /day (23 ± 5 °C; with Option 001)

Output:

- Range: -50 to +15 dBm at 50 Ω
- Resolution: 0.1 dB
- Unit: dBm, dB μ V, Vrms
- Level Accuracy:
 - Accuracy: ± 0.5 dB at +10 dBm, 50 MHz (23 ± 5 °C)
 - Linearity: ± 0.5 dB at -35 to +10 dBm
 - Flatness: ± 1.5 dB
- Impedance: Nominal 50 Ω
Return Loss (Typical):
 - ≥ 15 dB (at $\leq +5$ dBm)
 - ≥ 10 dB (at $> +5$ dBm)
- Connector: Type-N(f) connector
- Spectral Purity:
 - Harmonics: < -30 dBc at 10 dBm
 - Non-Harmonic Spurious: < -50 dBc at 10 dBm
 - Phase Noise: < -100 dBc/Hz at 20 kHz offset, SPAN ≤ 2.4 MHz

Sweep:

- Sweep Parameter: Frequency, Power, and DC Bias Voltage
- Power Sweep Range: Max. 26 dB at -50 to +15 dBm
- Power Sweep Linearity: ± 0.2 dB/10 dB at -50 dBm to +10 dBm
- Sweep Type:
 - Linear, Log, CW, Programmed Points, and Partial Sweeps the points set to the programmed points table. The sweep points, and resolution band width can be set.
 - Partial Sweep: Sweeps one part of the sweep range.
- Sweep Mode: Continuous, Single, Manual
- Trigger Mode: Internal, External, Manual
- Number of Measurement Points: 2 to 401 points

Table 7-1. Specifications (3 of 15)

- Sweep Time: Depends on RBW and sweep time.

RBW	Measurement Time/point
30 kHz	approximately 3 msec
3 kHz	approximately 5.3 msec
300 Hz	approximately 36 msec
30 Hz	approximately 254 msec

DC Bias Level:

- Range: -40 to +40 V (Max. 20 mA)
- Resolution: 10 mV
- Accuracy: $\pm(0.12\% + 5 \text{ mV})$ at $23 \pm 5^\circ\text{C}$

RECEIVER:

Input:

- Frequency Range: 10 Hz to 500 MHz
- Inputs: 4 Inputs (R1, T1, R2, T2)
- Connector: Type-N(f) connector
- Resolution Band Width: 3 Hz to 300 kHz, 1, 3, 10 steps
- Impedance: Nominal 50Ω
Return Loss ≥ 15 dB
- Attenuator: 0 to 50 dB, 10 dB step (for all Inputs)
- IF Range: Normal mode or High Sensitivity mode is selectable.
High Sensitivity mode is effective at the low level signal measurement.
- Input Range: Input range is changed by the Attenuator and IF range, as follows. The value of Input Range is displayed on the System Message Line.

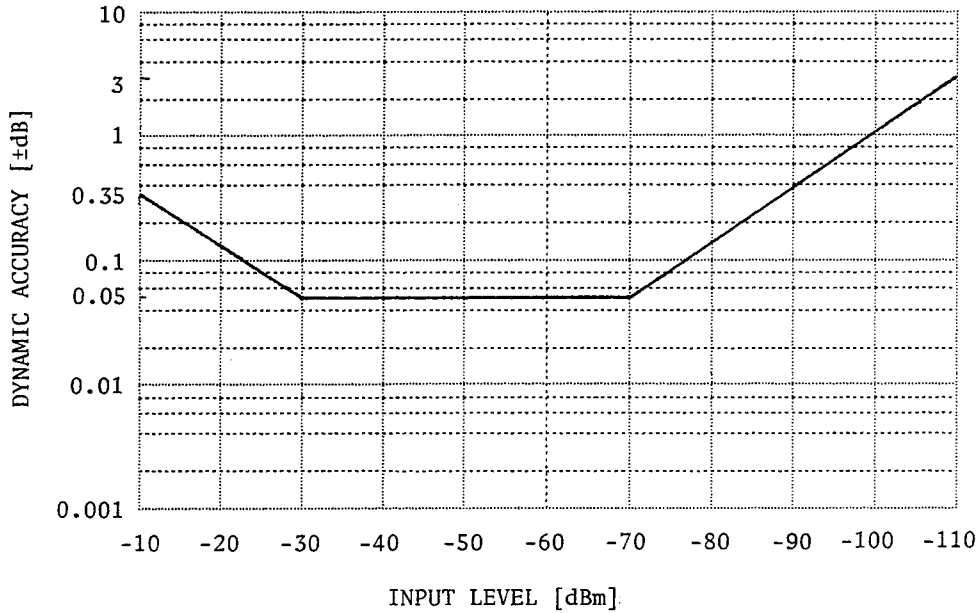
Attenuator	IF Range	
	Normal mode	High Sensitivity mode
0 dB	-10 dBm	-20 dBm
10 dB	0 dBm	-10 dBm
20 dB	10 dBm	0 dBm
30 dB	20 dBm	10 dBm
40 dB	20 dBm	20 dBm
50 dB	20 dBm	20 dBm

- Maximum Input Level: +20 dBm at 50Ω
- Damage Level: +30 dBm or ± 7 VDC (Typical)
- Input Cross Talk: < -100 dB at ≤ 400 MHz
 < -90 dB at > 400 MHz

Table 7-1. Specifications (4 of 15)

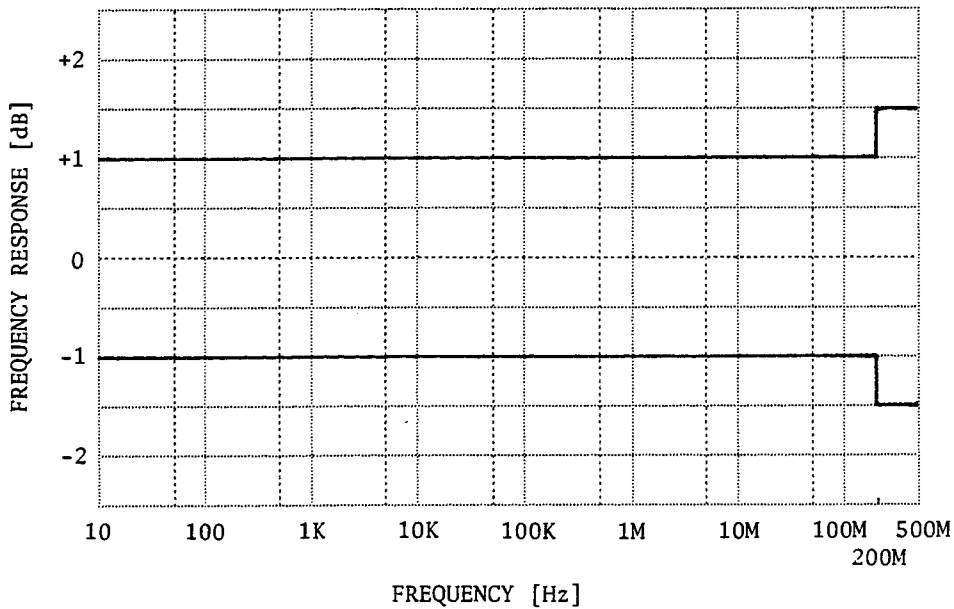
Magnitude Ratio (T/R):

- Dynamic Range: ≥ 100 dB
- Resolution: 0.001 dB
- Dynamic Accuracy (at $23 \pm 5^\circ\text{C}$):



Where: IF range: Normal mode
 Attenuators: 0 dB
 Reference Input Level: -30 dBm
 Resolution Band Width: 10 Hz

- Frequency Response: (The frequency response error can be reduced by NORMALIZE.)

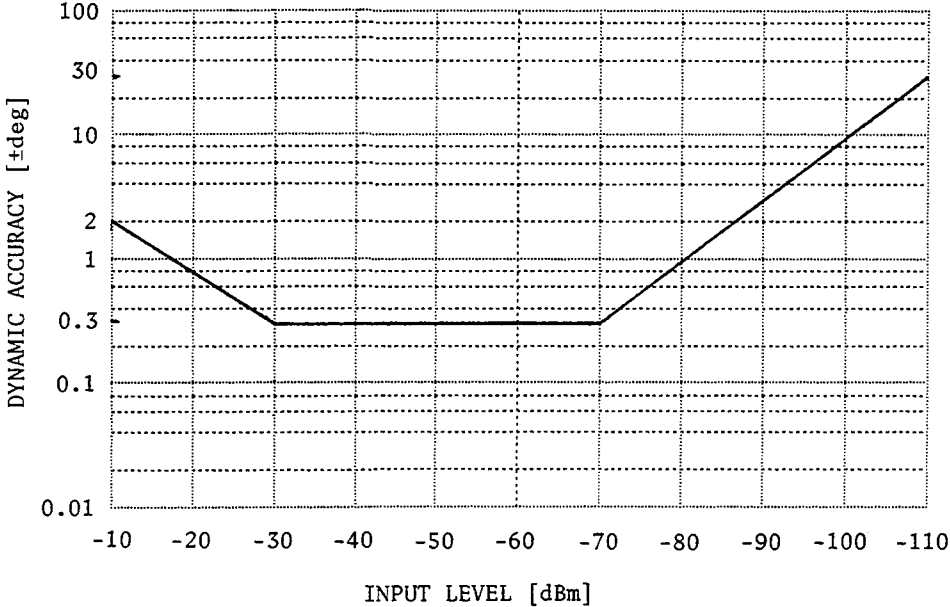


Where, the Input Attenuators for two inputs must be the same value, respectively.

Table 7-1. Specifications (5 of 15)

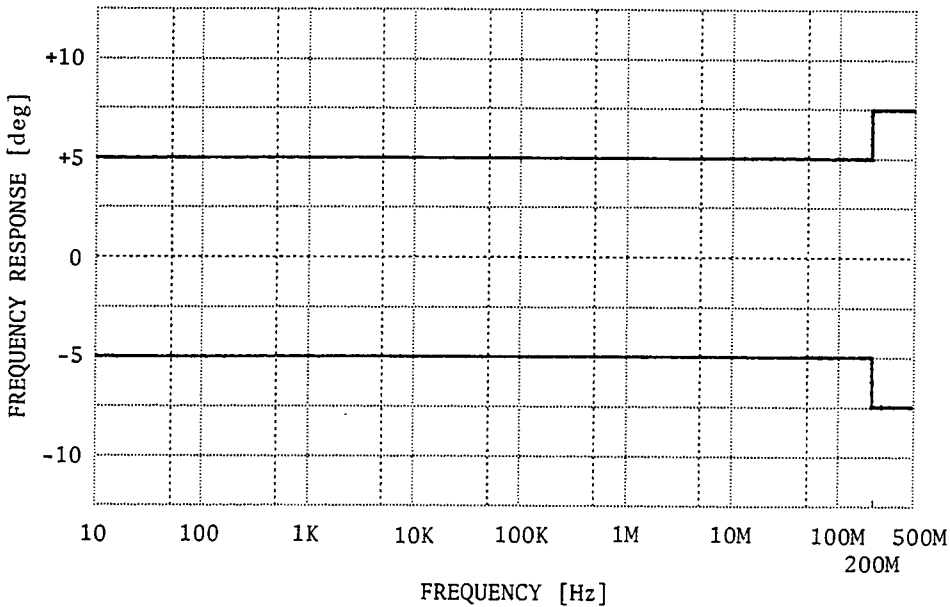
Phase:

- Range: ± 180 deg
- Resolution: 0.01 deg
- Dynamic Accuracy (at $23 \pm 5^\circ\text{C}$):



Where: IF range: Normal mode
Attenuators: 0 dB
Reference Input Level: -30 dBm
Resolution Band Width: 10 Hz

- Frequency Response: (Deviation from linear phase. The frequency response error can be reduced by the Normalize.)



Where, the Input Attenuators for two inputs must be the same value, respectively.

Table 7-1. Specifications (6 of 15)

Group Delay:	
• Range:	100 fsec to 500 sec
• Resolution:	$(2.78 \times 10^{-5}) / (\text{Aperture Frequency by Hz}) \text{ sec}$
• Aperture Frequency:	0.5% to 100% of SPAN at 401 point sweep
• Accuracy (at $23 \pm 5^{\circ}\text{C}$):	$\frac{\text{Dynamic Phase Accuracy (deg)}}{360 \text{ (deg)} \times \text{Aperture Frequency (Hz)}} \text{ (sec)}$
Calibration:	
• NORMALIZE:	Compensates for the frequency response error at the transmission or reflection measurement.
• 1 Port Partial Calibration:	Compensates for the frequency response error and the directivity error.
• 1 Port Full Calibration:	Compensates for the frequency response error, the directivity error, and the source match error.
• Port Extension:	Compensates for phase shift existing in the extension from the calibration plane. A new reference plane can be defined from -999.99 to +999.99 cm with 0.01 cm resolution.

Table 7-1. Specifications (7 of 15)

SPECTRUM MEASUREMENT

Frequency:

- Measurement Range: 10 Hz to 500 MHz
- Accuracy (CENTER, SPAN, START, STOP):
 - ±20 ppm (23 ±5 °C)
 - ±1 ppm (23 ±5 °C, Option 001)
- Resolution:
 - Resolution Bandwidth(3 dB): 3 Hz to 300 kHz, 1, 3, 10 steps
 - Selectivity (60 dB/3 dB):
 - <4.5 at RBW ≤ 30 Hz
 - <9 at 100 Hz ≤ RBW ≤ 10 kHz
 - <8.5 at RBW ≥ 30 kHz
- Band Width Accuracy: ±10%
- Standard Frequency Stability:
 - ±5 × 10⁻⁶/day (23 ±5 °C, Typical)
 - ±1 × 10⁻⁸/day (23 ±5 °C, with Option 001)
- Noise Sideband:
 - <-100 dBc/Hz at 20 kHz offset, SPAN≤2.4MHz
 - <-100 dBc/Hz at 1 kHz offset, SPAN≤2.4 MHz
 - <-90 dBc/Hz at 100 Hz offset, SPAN≤2.4 MHz
- SSB Noise (Typical):

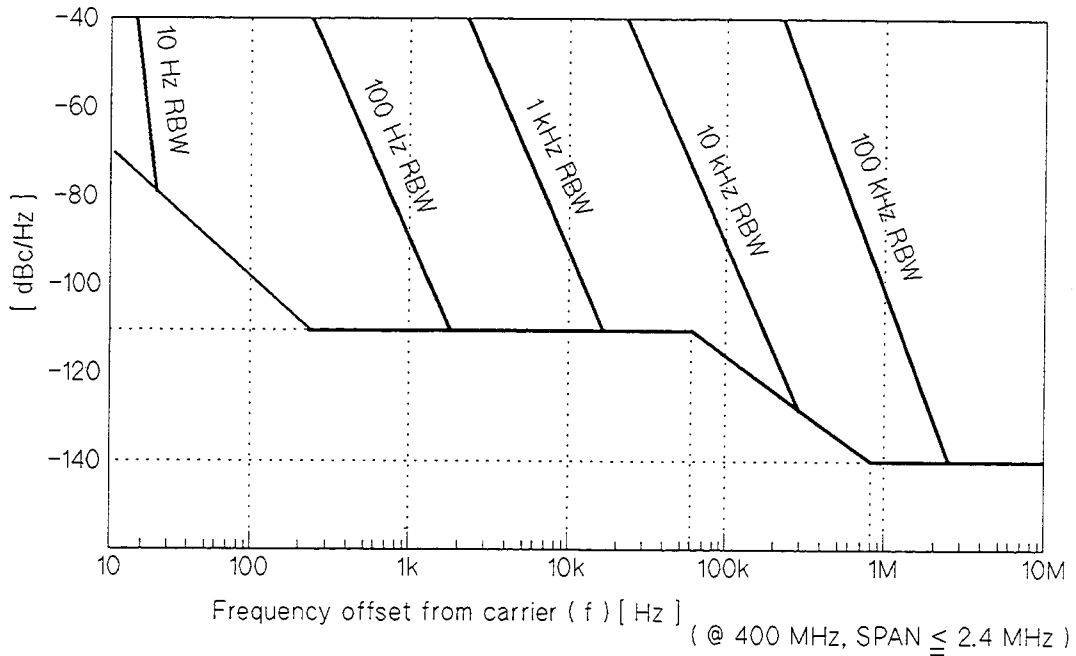


Table 7-1. Specifications (8 of 15)

Input Characteristics:

- Inputs: 4 Inputs (R1, T1, R2, T2)
- Impedance: Nominal 50Ω
Return Loss ≥15 dB
- Attenuator: 0 to 50 dB, 10 dB step (for all Inputs)
- IF Range: Normal mode, Low Distortion mode, or High Sensitivity mode is selectable.
- Input Range: Input Range is changed by the Input Attenuator, and IF Range, as follows. The value of Input Range is displayed on the System Message Line.

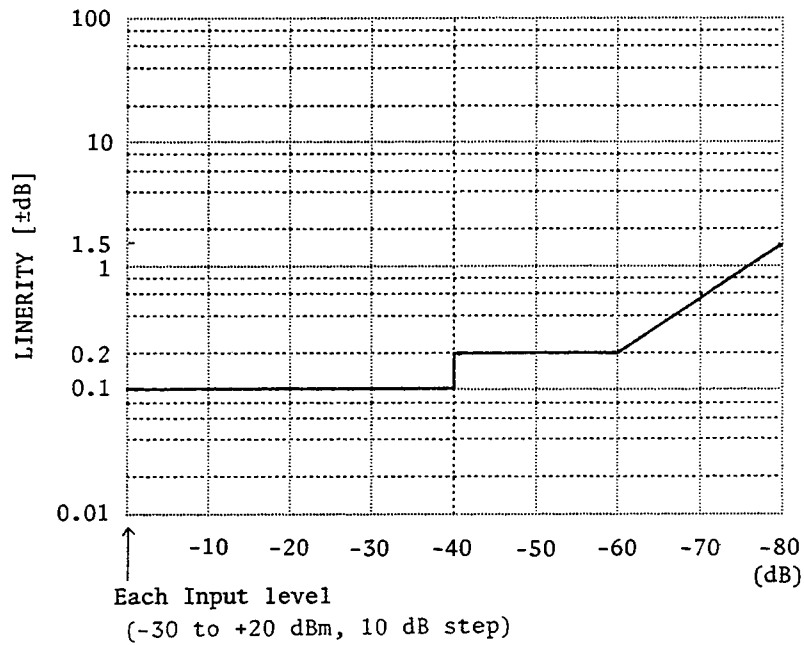
Attenuator	IF Range		
	Normal	Low Distortion	High Sensitivity
0 dB	-20 dBm	-30 dBm	-40 dBm
10 dB	-10 dBm	-20 dBm	-30 dBm
20 dB	0 dBm	-10 dBm	-20 dBm
30 dB	10 dBm	0 dBm	-10 dBm
40 dB	20 dBm	10 dBm	0 dBm
50 dB	20 dBm	20 dBm	10 dBm

- Maximum Input Level: +20 dBm
- Damage Level: +30 dBm or ±7 VDC (Typical)

Table 7-1. Specifications (9 of 15)

Amplitude:

- Measurement Range: -135 dBm to +20 dBm
- Unit: dBm, dB μ V, Vrms, dBm/Hz, and μ Vrms/ \sqrt Hz
- Accuracy: ± 1.0 dB at 50 MHz, 23 ± 5 °C (at the upper limit level of Input Range)
- Linearity (at 23 ± 5 °C):



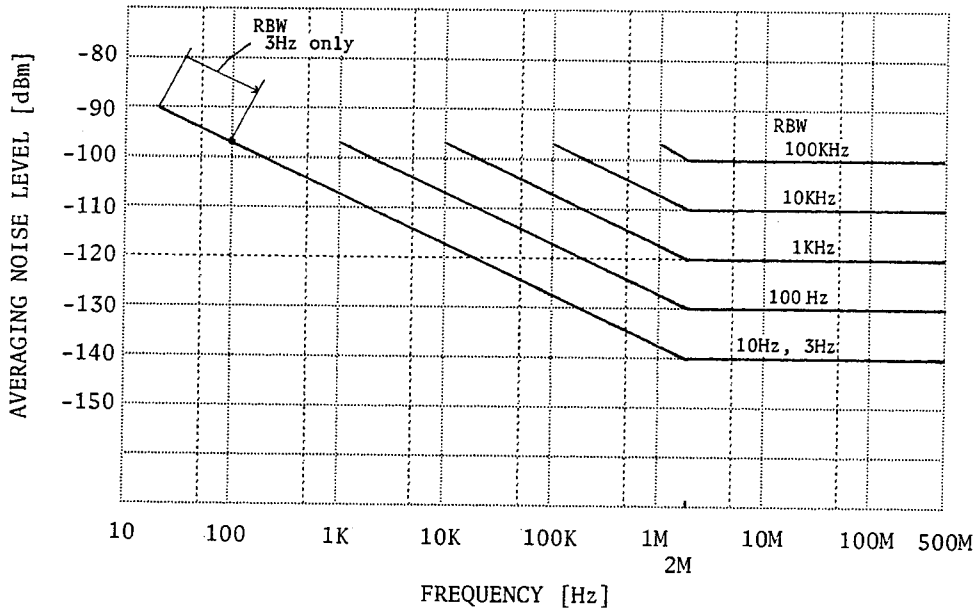
Where: IF Range: Low Distortion mode
Resolution Band Width: 10 Hz

- Frequency Response: ± 1.5 dB when Attenuator= 10 dB

Table 7-1. Specifications (10 of 15)

Dynamic Range: (at 23 ±5°C)

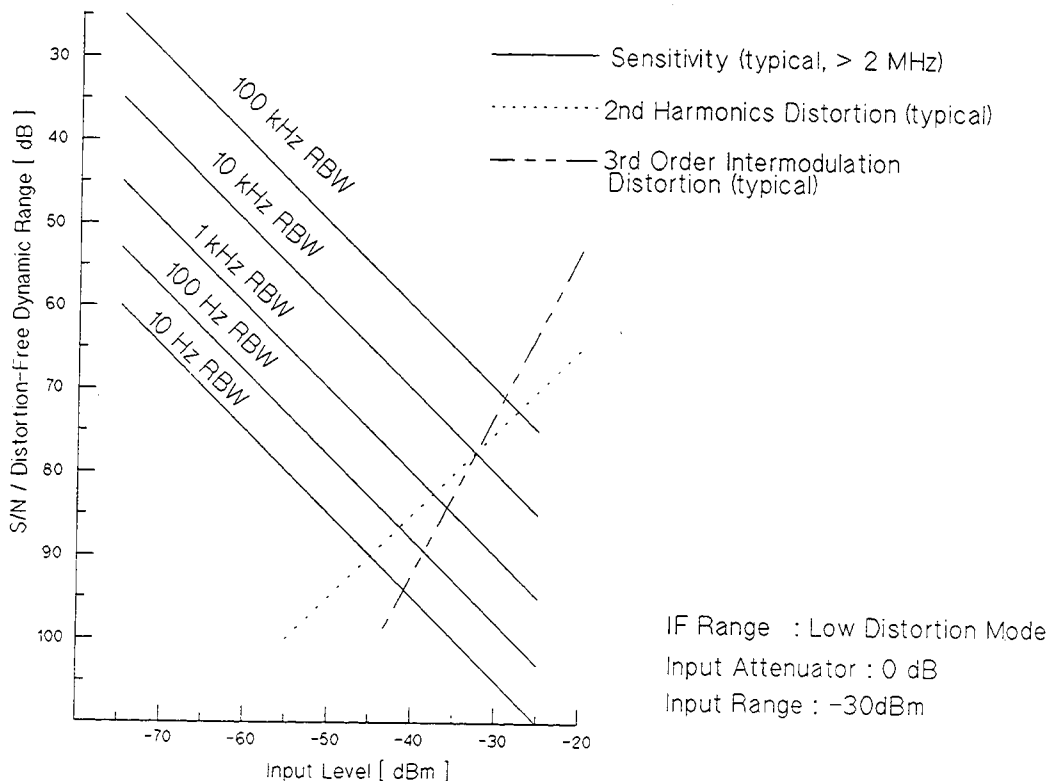
- Spurious Response: ≤-70 dBc
(at the frequency offset from carrier ≥100 kHz when SPAN > 2.4 MHz)
- 2nd Harmonics Distortion: ≤-70 dBc referenced to the sinusoidal signals (≥2 MHz) which is equal to every Input Ranges
(IF Range: Low Distortion mode)
- 3rd Order Intermodulation Distortion: ≤-80 dBc referenced to two sinusoidal signals (≥2 MHz; 500 kHz separation) which are lower 6dB than every Input Ranges
(IF Range: Low Distortion mode)
- Residual Response: -110 dBm at ≥100 kHz, Attenuator= 0 dB
(IF Range: High Sensitivity mode)
- Averaging Noise Level (Typical):



Where: IF Range: High Sensitivity mode
Attenuator: 0 dB

Table 7-1. Specifications (11 of 15)

• Dynamic Range Chart:



Sweep:

- Sweep Type: Liner, Log, CW, Programmed Points, and Partial
- Sweep Mode: Continuous, Single, and Manual
- Trigger Mode: Internal, External, and Manual
- Sweep Time: (where Display points : 401 points)

Span	RBW	Measurement Time/point
500 MHz	300 kHz	approximately 3.5 sec
100 MHz	300 kHz	approximately 750 msec
50 MHz	300 kHz	approximately 350 msec
1 MHz	3 kHz	approximately 1 sec
100 kHz	300 Hz	approximately 11 sec

Table 7-1. Specifications (12 of 15)

IMPEDANCE MEASUREMENT

The following specifications are applied only when the 4195A is used with the HP 41951A Impedance Test Kit.

Measurement Parameter: $|Z|$, $|Y|$, θ , R, X, G, B, L, C, D, Q (=1/D)

Frequency Range: 100 kHz to 500 MHz

Test Signal Level: -62 dBm to +3 dBm at 50Ω load

DC Bias Level: ±40 V (Max. 20 mA)

Measurement Range: 30 mΩ to 30 kΩ
(Typical, after a 1 Port Calibration)

Measurement Basic Accuracy: (Typical, at 23 ±5 °C, after a 1 Port Calibration)

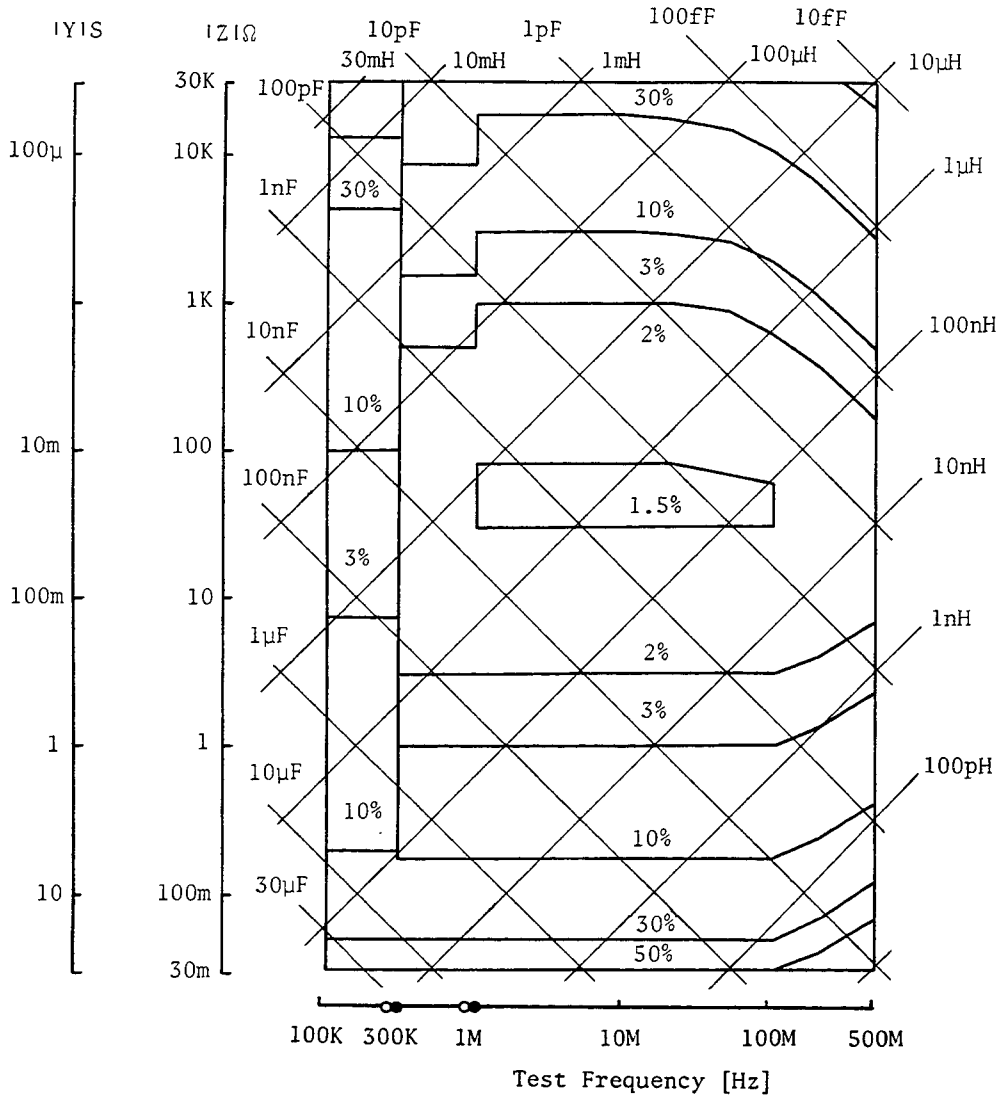


Table 7-1. Specifications (13 of 15)

Error Correction Capability:	<ul style="list-style-type: none">• 1 Port Full Calibration• Open/Short Offset Compensation• Port Extension
Equivalent Circuit Analysis Capability:	
<ul style="list-style-type: none">• Approximation:	Approximate equivalent circuit constants using impedance measurement data.
<ul style="list-style-type: none">• Simulation:	Simulate the frequency characteristics of impedance by specifying the equivalent circuit constants.

Table 7-1. Specifications (14 of 15)

--- AVAILABLE FUNCTIONS ---	
DISPLAY AND ANALYSIS:	
Display:	7.5 inch color CRT
Display Format:	Rectangular (X-A&B, A-B), Smith chart, Polar chart, and Table
Trace:	Maximum 4 traces
Scale Type:	Liner, Log
Auto Scaling Function:	Optimize scaling of the displayed data
Phase Display Extend Function:	Displays continuously the phase over ± 180 deg.
Video Filter:	Average the measurement data of four measurements.
Comment Entry:	Display up to a 26 character comment on the CRT.
Marker:	NEXT PEAK, Marker Target, Delta Marker, NOISE Marker, MKR \rightarrow MAX(MIN, REF, CENTER, START, STOP)
Math Operator/Math Function:	+, -, *, /, SQR, EXP, LOG, LN, SIN, COS, TAN, ATAN, ABS, DIF, MAX(,), MIN(,), COMPLEX< , > and etc.
USER FUNCTION:	
User Math Function:	Change the format of the measured data, using the math operators/math functions at the real time.
User Defined Function:	Define the control of measurement and analysis to a softkey.
User Program:	Control the 4195A's operation using the internal program language. The program can be entered using the front panel keys or down loaded from a host computer using HP-IB.

Table 7-1. Specifications (15 of 15)

HARD COPY:

Copy to HP plotters or printers set to the LISTEN ONLY mode without an external computer.

- DUMP Graphics mode:** Copy the CRT display on a graphics printer.
- Color DUMP Graphics mode:** Copy the CRT display on a color graphics printer (fixed color).
- PLOT mode:** Copy the CRT display on a plotter for a color hardcopy.
- PRINT mode:** Output measurement data in tabular form on a printer.

STORAGE

Save/get the measurement condition, measured data, User Program (ASP), programmed points table to the 3.5 inch flexible disc by the internal disc drive.

- Capacity:** 630 k byte, Double Sided
- Format:** LIF

REMOTE PROGRAMMING

Based on IEEE STD 488-1978, IEEE STD 728-1982.

- Interface Function:** SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1
- Data Output Format:** ASCII, Binary IEEE 32 or 64 bit
- Data Transfer Rate (Typical):** Using the **ENTER** command with an HP 9000 series 310 computer, 401 point data.

Data Format	Transfer Rate
ASCII	Approximately 700 msec
Binary 32-bit	Approximately 40 msec
Binary 64-bit	Approximately 90 msec

Table 7-2. Options

Option Number	Description
001	High Stability Frequency Reference Test Frequency Accuracy: ± 1 ppm ($23 \pm 5^{\circ}\text{C}$) Stability: $\pm 1 \times 10^{-8}$ /day ($23 \pm 5^{\circ}\text{C}$)
907 * ¹	Front Handle Kit
908 * ¹	Rack Flange Kit
909 * ¹	Rack & Handle Kit
910	Extra Operation Manual (English)
91P	Extra Operation Manual (Japanese)

*¹: Installation procedures for these options are detailed in paragraph 7-6.

Table 7-3. Furnished Accessories

Description	Qty.	HP Part Number or Model Number
Disc Kit 3.5inch Disc (2ea.) Disc Case (1ea.)	1 ea.	04195-61001
Cable Assy (Power)	1 ea.	04194-61603
Cable Assy (Control)	1 ea.	04194-61602
BNC-BNC Cable	3 ea.	8120-1838
BNC-BNC Cable (Option 001 only)	1 ea.	04194-61601
Rear Panel Lock Foot Kit Full Modules	1 ea.	5061-9699
Power Cable	1 ea.	8120-1378
Maintenance Manual	1 ea.	04195-90100
User's Guide	1 ea.	5950-2942