

Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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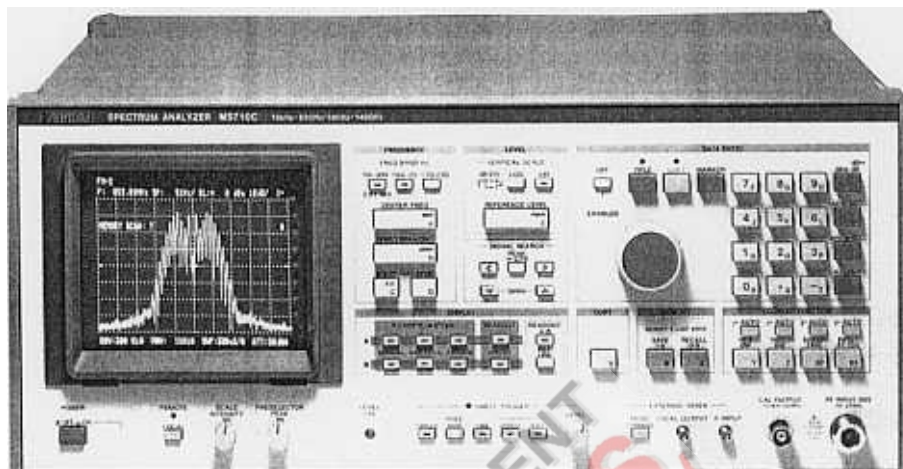
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SPECTRUM ANALYZER

MS710C/D/E/F

10 kHz to 23 GHz (18 to 140 GHz)



GPIB

The MS710C/D/E/F has been designed as a high-performance microwave spectrum analyzer with wide user applications. The MS710C/D/E/F is easy-to-use and has a variety of functions suited to users' requirements.

Use of a simplified PLL synthesizer local oscillator gives a high accuracy of 30 kHz/6.5 GHz (MS710C/E) and a high resolution of 100 Hz/6 dB (≈ 70 dB/3 dB).

Other features include wide dynamic range (second harmonics ≤ -100 dB) and an optional, wide measurement frequency range of up to 140 GHz by using external mixers. This fundamental performance is required by most users. In addition, a two-channel digital memory enables simultaneous display of two measured data, display of subtraction results and processing functions such as MAX HOLD and AVERAGING. By using these functions, the MS710C/D/E/F can provide many display/record-related functions such as signal search, and marker point data readout for numeric display and direct plotting. A new function which enables store/recall of up to 9 sets of measured data and measurement conditions has also been added.

The MS710C/D/E/F has been designed for both easy manual operation and completely automatic operation via GPIB. The design includes:

- (1) a grouped key layout with different key sizes depending on their functional importance,
- (2) an operation guide display for complicated operations such as SHIFT and MARKER functions, and
- (3) a preset memory which can memorize up to 10 sets of measurement conditions.

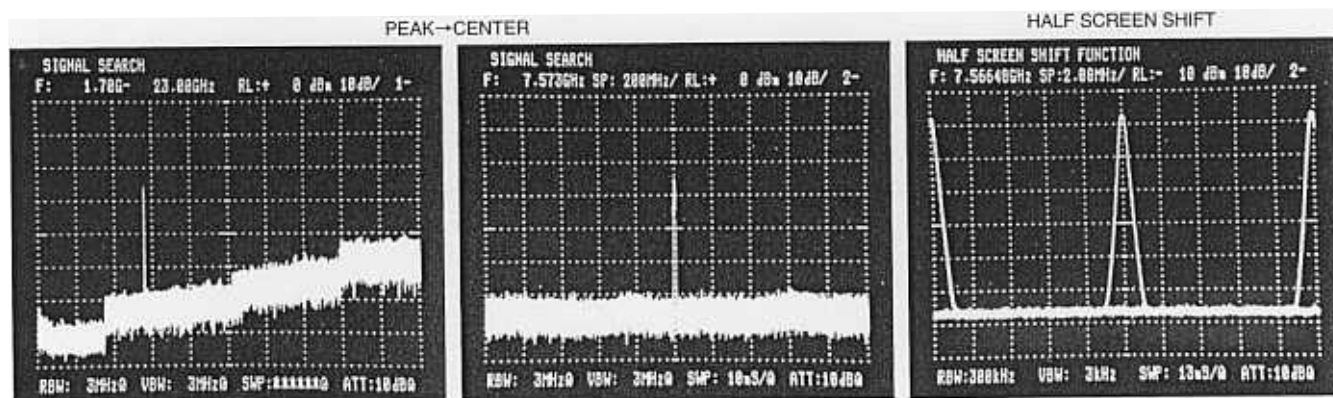
Main applications

- Spectrum analysis of microwave devices and components
- Spurious emission and spectral distribution measurements of analog and digital communications transmitters
- Interference measurements for radio stations, satellite earth stations, etc.
- Spectrum analysis in basic research such as nuclear physics and radio-astronomy
- Spurious measurements for home-use satellite broadcast receivers and related equipment

Functions

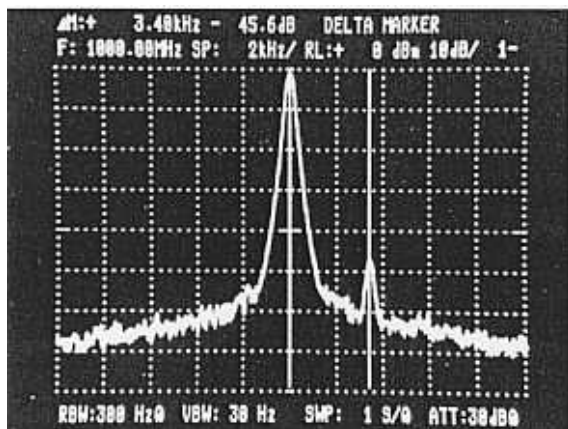
- Wide variety of signal search functions

The special-purpose PEAK→CENTER SPAN UP/DOWN and HALF SCREEN SHIFT keys enable rapid location of the desired signal.



● Marker

Five marker functions (Normal, Delta, Peak, Marker → CF and Signal Track) are provided. In Signal Track, during successive sweeps, the marker continuously tracks the peak signal and at the start of each sweep, the marker frequency is moved automatically to the center frequency to hold the signal around the center of the screen. For the convenience of users, Signal Track is automatically stopped when the signal is lost. The photo shows the delta marker which enables reading of the frequency and level differences between two markers.



● List display based on operability research

Five list displays enable effective use of the many functions. The displays are classified into two types: operation procedures and memory contents. As an example of each type (1) the marker function list and (2) measurement condition list are shown below.

MARKER FUNCTION LIST

NORMAL MARKER...CENTER FREQ
DELTA MARKER...FREQ SPAN/DIV
PEAK MARKER...REF LEVEL
MARKER→CTR...PEAK→CTR
MARKER OFF.....OFF

< SELECT KEY >

Marker function list

MEMORY < 5 > < 6 > < 7 > < 8 > < 9 >
CTR : 100.0M 11.700G
SPAN : 10k/ 15k/
START : 2.000G
STOP : 10.000G
REF : + 0dB - 32dB - 10dB
SCALE : 10dB/ 10dB/ 10dB/
RBW : 1k 1k 3M
VBW : 3k 3k 3M
SMP : 60ns/ 90ns/
ATT : 30dB 10dB 10dB
SHIFT:OFF:0...4 SAVE: 1...9 CLEAR:-1...-9

Measurement condition list

MS710C/D/E/F selection guide

Model	10 kHz to 30 MHz	100 kHz to 2 GHz, 1.7 to 23 GHz	18 to 140 GHz (with external mixer)	High frequency accuracy
MS710C	√	√	√	√
MS710D		√		
MS710E		√		
MS710F		√		

Specifications

• 100 kHz to 2 GHz and 1.7 to 23 GHz band

Model		MS710C/E	MS710D/F
Frequency	Measuring range	100 Hz to 2 GHz, 1.7 to 23 GHz	
	Setting range	0 MHz to 2 GHz, 1.7 to 23 GHz	
	Readout resolution	10 kHz (0 MHz to 2 GHz) 10 kHz (1.7 to 23 GHz)	100 kHz (0 MHz to 2 GHz) 1 MHz (1.7 to 23 GHz)
	Center frequency	\pm (the following accuracy +2% of frequency span +10% of resolution bandwidth)	
	Readout accuracy	30 kHz (0 MHz to 2 GHz, 1.7 to 6.5 GHz) 60 kHz (6.5 to 12.5 GHz) 90 kHz (12.5 to 18.5 GHz) 120 kHz (18.5 to 23 GHz)	1 MHz (0 MHz to 2 GHz, 1.7 to 6.5 GHz) 2 MHz (6.5 to 12.5 GHz) 3 MHz (12.5 to 18.5 GHz) 4 MHz (18.5 to 23 GHz)
	Setting	Number/unit keys, data knob, peak center key, or half-screen shift key	
	Frequency span	Setting range and resolution: The following and 0 Hz (fixed tuning) in number/unit keys and in data knob 1 kHz/div to 200 kHz/div in 1 kHz increments 210 kHz/div to 2 MHz/div in 10 kHz increments 2.1 to 20 MHz/div in 100 kHz increments 21 to 200 MHz/div in 1 MHz increments For span up/down keys: 1 kHz/div to 200 MHz/div in 1-2-5-10 sequence Readout accuracy: \pm 5% (6 kHz/div to 200 MHz/div), \pm 10% (1 to 5 kHz/div) Setting: Number/unit keys, data knob, or span up/down keys	
	Start/stop frequency	Setting range In each band (span \geq 10 kHz)	In each band (span \geq 1 MHz)
	Readout resolution	Min. 10 kHz (various with span settings) (span = stop frequency - start frequency)	1 MHz (span \leq 200 MHz) 10 MHz (span \leq 210 MHz) (span = stop frequency - start frequency)
	Readout accuracy	\pm (center frequency accuracy) + 2.5% of span)	
	Setting	Number/unit keys or data knob	
Amplitude	Resolution	Resolution bandwidth (6 dB bandwidth) Setting range: 100 Hz to 3 MHz in 1-3-10 sequence Setting: Selectable manually or automatically coupled to frequency span Selectivity (60 dB/3 dB): \leq 10 : 1 (resolution bandwidth \geq 1 kHz)	
	Stability	Residual FM: \leq 200 Hzp-p/0.1 s (center frequency; \leq 6.5 GHz, span; \leq 100 kHz/div) Noise sidebands: \leq -75 dB (1 kHz resolution bandwidth, 10 Hz video bandwidth, 30 kHz from signal, center frequency \leq 6.5 GHz)	
	Measuring range	Average noised level to +30 dBm	
	Graticule	Vertical 8 divisions, reference level is top line of graticule	
	LOG	10 dB/div: 0 to -70 dB from reference level 5 dB/div: 0 to -40 dB from reference level 2 dB/div: 0 to -16 dB from reference level 1 dB/div: 0 to -8 dB from reference level	
	LIN	12.5%/div	
	Linearity	\pm 0.2 dB/1 dB, \pm 1.5 dB/70 dB	
	Reference level	Setting range: -109 to +30 dBm Calibration output accuracy: -10 dBm \pm 0.3 dB (100 MHz \pm 10 kHz) Reference level accuracy: \pm 2.0 dB (reference level; -99 to -10 dBm, frequency; 100 MHz, 0 dB input attenuator, and after calibrated using CAL OUTPUT) Input attenuator accuracy Setting range: 0 to 70 dB, 10 dB steps, selected manually or automatically coupled to reference level Error between steps: \pm 1 dB (0 to 60 dB, 100 kHz to 2 GHz), \pm 2 dB (0 to 40 dB, 100 kHz to 23 GHz) Maximum accumulation error: \pm 2.2 dB (0 to 60 dB, 100 kHz to 2 GHz), \pm 3 dB (0 to 40 dB, 100 kHz to 23 GHz) Frequency response: 10 dB input attenuator after preselector peak adjustment to obtain maximum response \pm 2.5 dB (100 kHz start frequency, 10 MHz stop frequency) \pm 1.5 dB (10 MHz start frequency, 2 GHz stop frequency) \pm 2.5 dB (1.7 GHz start frequency, 5.48 GHz stop frequency) \pm 3 dB (5.48 GHz start frequency, 12.52 GHz stop frequency) \pm 4 dB (12.52 GHz start frequency, 23 GHz stop frequency)	

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Model		MS710C/E	MS710D/F
Amplitude	Dynamic range	2nd harmonic distortion: ≤ -60 dB (input frequency 100 kHz to 10 MHz, value obtained by subtracting input attenuator value from input level -40 dBm) ≤ -70 dB (input frequency 10 to 200 MHz, value obtained by subtracting input attenuator value from input level -30 dBm) ≤ -80 dB (input frequency 200 to 850 MHz, value obtained by subtracting input attenuator value from input level -30 dBm) ≤ -100 dB*1 (input frequency 850 MHz to 11.5 GHz [1.7 to 23 GHz band], value obtained by subtracting input attenuator value from input level -10 dBm)	
		Two signal 3rd intermodulation distortion: ≤ -80 dB (input frequency; 100 kHz to 2 GHz, frequency difference of two signal input; ≥ 2.5 MHz, value obtained by subtracting input attenuator value from input total level; -30 dBm) ≤ -100 dB*1 (input frequency; 1.7 to 12.5 GHz, frequency difference of two signal input; ≥ 70 MHz, value obtained by subtracting input attenuator value from input total level; -10 dBm) ≤ -100 dB*1 (input frequency; 12.5 to 23 GHz, frequency difference of two signal input; ≥ 100 MHz, value obtained by subtracting input attenuator value from input total level; -10 dBm)	
		Residual response: ≤ -90 dBm (0 dB input attenuator, 10 MHz to 6.5 GHz fundamental mixing, and 50 Ω termination) Average noise level: ≤ -95 dBm (100 kHz to 1 MHz), ≤ -115 dBm (1 MHz to 2 GHz), ≤ -110 dBm (1.7 to 6.5 GHz), ≤ -100 dBm (6.5 to 12.5 GHz), ≤ -95 dBm (12.5 to 18.5 GHz), ≤ -88 dBm (18.5 to 23 GHz) At 1 kHz resolution bandwidth, 0 dB input attenuator, and 3 Hz bandwidth	
		Video bandwidth: 1 Hz to 3 MHz, 1-3-10 sequence Selected manually or automatically coupled to frequency span	
Marker		Connector: N-type (nominal 50 Ω)	
		Maximum input level: $+30$ dBm, ± 0 Vdc	
		Frequency and level at marker displayed	
		1/50 of span/div or 1 kHz whichever greater	1/50 of span/div or 10 kHz whichever greater
Marker		1/100 of span/div	
		Frequency and level difference at two markers displayed	
		1/50 of span/div	
		Marker always tracks peak position and shows frequency and level (readout resolution same as Normal Marker resolution)	
CRT display		Marker frequency set to center frequency	
		CRT Display area: 80 mm \times 100 mm Display item: Graticule, signal traces, function setting value, error message, title, frequency band list, shift function list, and memory list	
		Signal traces Memory capacity: Horizontal 501 points, vertical 801 points, A and B traces, backed-up by battery Display: NORMAL, MAX HOLD, AVERAGE, A \rightarrow B, A \leftrightarrow B	
		Up to 10 sets of each function setting can be saved or recalled. The memory list can be displayed on the CRT, backed-up by battery.	
Function setting memory		Up to 9 sets of display (title, function settings, signal trace) can be saved or recalled.	
		Sweep time:	
		2 ms/div to 10 s/div. May be selected manually or automatically coupled to frequency span, resolution bandwidth, and video bandwidth. For 0 Hz frequency span, 2 μ s/div to 10 s/div with manual setting. When (stop frequency - start frequency) > 2 GHz, the previous time is set and time cannot be set manually.	
		Trigger: Signal, free run, line, video, and external trigger	
Sweep		GPIB (IEEE488, IEC625-1, 24 pins), all front panel functions (except power switch, CRT intensity, level calibration, and trigger level adjustment knob) can be remote-controlled.	
		Remote-control	
		CRT information can be plotted by the specified plotter or printer	
		Power	
Dimensions and mass		AC 100 V $\pm 10\%$, 50/60 Hz, ≤ 200 VA	
		177H \times 426W \times 451D mm, ≤ 27 kg	

*1: Less than specified level or average noise level

● 10 kHz to 30 MHz band (MS710C)

Frequency	Measuring frequency	10 kHz to 30 MHz
	Center frequency	Setting range: 0 kHz to 30 MHz Readout resolution: 1 kHz Readout accuracy: $\pm(3 \text{ kHz} + 2\% \text{ of frequency span} + 10\% \text{ of resolution bandwidth})$
	Frequency span setting range and resolution	The following and 0 Hz (fixed tuning) in number/unit keys and in data knob 1 to 200 kHz/div in 1 kHz increments 210 kHz/div to 2 MHz/div in 10 kHz increments 2.1 to 3 MHz/div in 100 kHz increments For span up/down keys: 1 kHz/div to 2 MHz/div in 1-2-5-10 sequence and 3 MHz/div
Amplitude	Frequency response	$\pm 1.5 \text{ dB}$ (10 kHz start frequency, 30 MHz stop frequency, 10 dB input attenuator)
	Dynamic range	2nd harmonic distortion: $\leq -60 \text{ dB}$ (input frequency 10 to 300 kHz, value obtained by subtracting input attenuator value from input level -40 dBm) $\leq -70 \text{ dB}$ (input frequency 300 kHz to 15 MHz, value obtained by subtracting input attenuator value from input level -30 dBm) Two signal 3rd intermodulation distortion: $\leq -70 \text{ dB}$ (input frequency 10 to 100 kHz, frequency difference of two signal input $\geq 2.5 \text{ MHz}$, value obtained by subtracting input attenuator value from input total level -30 dBm) Residual response: $\leq -90 \text{ dBm}$ Average noise level: $\leq -95 \text{ dBm}$ (100 kHz to 1 MHz), $\leq -115 \text{ dBm}$ (1 to 30 MHz) 1 kHz resolution bandwidth, 0 dB input attenuator, and 3 Hz video bandwidth

*: Other specifications are the same as the 100 kHz to 2 GHz and 1.7 to 23 GHz band specifications.

● 18 to 140 GHz band (with external mixer)

Model		MS710C	MS710D
Frequency	Frequency band and harmonic number		18.0 to 26.5 GHz: 6, 22.0 to 33.0 GHz: 6, 26.5 to 40.0 GHz: 8, 40.0 to 60.0 GHz: 10, 60.0 to 90.0 GHz: 16, 90.0 to 140.0 GHz: 26
	Center frequency	Setting range	In each band
		Readout resolution	100 kHz (18 to 60 GHz), 1 MHz (60 to 140 GHz)
		Readout accuracy	30 kHz \times harmonic number
		Setting	Number/unit keys, data knob, peak center key, or half-screen shift key
	Frequency span		Setting range and resolution: The following and 0 Hz (fixed tuning) in number/unit keys and in data knob 1 kHz \times n/div to 200 kHz \times n/div in 1 kHz \times n increments 210 kHz \times n/div to 2 MHz \times n/div in 10 kHz \times n increments 2.1 MHz \times n/div to 20 MHz \times n/div in 100 kHz \times n increments 21 MHz \times n/div to 200 MHz \times n/div in 1 MHz \times n increments For span up/down keys: 1 kHz \times n/div to 200 MHz \times n/div in 1 \times n, 2 \times n, 5 \times n, 10 \times n sequence (n: harmonic number) Readout accuracy: $\pm 5\%$ (6 kHz \times n/div to 200 MHz \times n/div), $\pm 10\%$ (1 kHz \times n/div to 5 kHz \times n/div) Setting: Number/unit keys, data knob, or span up/down keys
	Start/stop frequency	Setting range	In each band (span $\geq 10 \text{ kHz} \times n$)
		Readout resolution	Min: 10 kHz \times n (varies with span settings) Span = stop frequency - start frequency
		Readout accuracy	\pm (center frequency accuracy + 2.5% of span)
		Setting	Number/unit keys or data knob
	Resolution	Resolution bandwidth (6 dB bandwidth)	Setting range: 100 Hz to 3 MHz in 1-3-10 sequence Setting: Selected manually or automatically coupled to frequency span
		Selectivity (60 dB/6 dB)	≤ 10 : 1 (resolution bandwidth $\leq 1 \text{ kHz}$)
Amplitude	Measuring range		Average noise level to +30 dBm
	Display	Graticule	Vertical 8 division, reference level is top line of graticule
		LOG	10 dB/div: 0 to -70 dB from reference level 5 dB/div: 0 to -40 dB from reference level 2 dB/div: 0 to -16 dB from reference level 1 dB/div: 0 to -8 dB from reference level
		LIN	12.5%/div
		Linearity	$\pm 0.2 \text{ dB/1 dB}$, $\pm 1.5 \text{ dB/70 dB}$
	Reference level	Setting range	-105 to +30 dBm (LOG), -95 to +30 dBm (LIN)
		Calibration output accuracy	-10 dBm $\pm 0.3 \text{ dB}$ (100 MHz $\pm 10 \text{ kHz}$)
		Reference level accuracy	$\pm 2.0 \text{ dB}$ (reference level -99 to -10 dBm, frequency 100 MHz, 0 dB input attenuator, and after calibration using CAL OUTPUT)
		Frequency response	Depends on external mixer
	Average noise level		Depends on external mixer (-100 dBm typical with 30 dB external mixer conversion loss, 1 kHz resolution bandwidth)
	Video bandwidth		1 Hz to 3 MHz, 1-3-10 sequence Selected manually or automatically coupled to frequency span

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Model	MS710C	MS710D
Normal	Frequency and level at markers displayed	
Frequency readout resolution	1/50 of span/div or 1 kHz × n whichever greater	1/50 of span/div or 10 kHz × n whichever greater
Level readout resolution	1/100 of scale/div	
Δ (delta)	Frequency and level difference at two markers displayed	
Frequency readout resolution	1/50 of span/div	
Level readout resolution	1/100 of scale/div	
Peak	Marker always tracks peak position and shows frequency and level (readout resolution same as normal marker resolution)	
MKR→CF	Marker frequency set to center frequency	
Local output for external mixer	3 to 6 GHz, ≥+7 dBm	
IF input for external mixer	521.4 MHz	

Other specifications are the same as the 100 kHz to 2 GHz and 1.7 to 23 GHz band specifications.

Peripherals and optional accessories

● Plotters and printers

Typical plotters that can be used for direct plotting are classified into three groups according to their types of command. The interfaces are GPIB or Centronics-style 8-bit parallel.

Manufacture	Country	Model
GRAPHTEC	Japan	PD9411
GRAPHTEC	Japan	FP6302
Hewlett Packard	USA	7475A
Hewlett Packard	USA	7470A

● Printer

Manufacture	Country	Model
EPSON	Japan	CTM-800

● Recommended external waveguide mixer

Tektronix: WM780 series (18 to 140 GHz, 2 port type)

Hewlett Packard: 11970 series (18 to 110 GHz, 3 port type)

Note: An additional amplifier (such as MP11975A) is required when using the HP11970 series mixer for local signal amplification.

● Measuring cable

Recommended measuring cables are as follows: (product of JUNKOSHA Co., Ltd.)

(1) JUNFLON microwave coaxial cable assembly

(2) DGM010-02000EE (general type, 2 m, N-P, 3.1 dB loss at 10 GHz)

(3) DGM024-02000EE (low loss type, 2 m, N-P, 2.5 dB loss at 10 GHz)

Ordering information

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

Model/Order No.	Name
Main frame	
MS710C	Spectrum Analyzer (10 kHz to 23 GHz/18 to 140 GHz)
MS710D	Spectrum Analyzer (100 kHz to 23 GHz/18 to 140 GHz)
MS710E	Spectrum Analyzer (100 kHz to 23 GHz)
MS710F	Spectrum Analyzer (100 kHz to 23 GHz)
Standard accessories	
J0104A	Coaxial cord, 1 m (BNC-P·RG-55/U·N-P): 1 pc
J0017	Power cord, 1 m (plug type must be specified.): 1 pc
F0013 (F0011)	Fuse, 5 A or 2 A: 2 pcs
F0010	Fuse, 1.6 A: 1 pcs
F0011	Fuse, 2 A: 1 pcs
F0012	Fuse, 3.15 A: 1 pcs
W0087AE	MS701□ operation manual: 1 copy
W0087BE	MS701□ service manual: 1 copy
Option	
MS710□-01	Occupied frequency bandwidth calculation function
Optional accessories	
MP614A	50 Ω ↔ 75 Ω Impedance Transformer
J0078	20 dB high power attenuator
J0064A	(N-type connector, 10 W, DC to 18 GHz)
J0064C	Coaxial to 7 GHz band waveguide adaptor
MP59B	(5.8 to 8.6 GHz, BRJ-7·N-J)
J0114A	Coaxial to 10 GHz band waveguide adaptor
DGM010-02000EE	(8.2 to 12.4 GHz, BRJ-10·N-J)
DGM024-02000EE	Coaxial Switch (DC to 3 GHz)
J0309	Coaxial cord, 1 m (N-P·RG-9A/U·N-P, general use)
J0004	Coaxial cord, 2 m (N-type connector, general use)
J0007	Coaxial cord, 2 m (N-type connector, low-loss type)
J0008	Mixer cable, 1 m (HRM-202B·RG58A/U·HRM-202B)
J0409	Coaxial adaptor (N-P·SMA-J)
J0410	GPIB cable, 1 m
B0115C	GPIB cable, 2 m
B0063	Centronics cable, 1 m (for printer)
B0020	Centronics cable, 2 m (for printer)
B0029	CRT hood
B0038	Carrying case (for standard type)
B0043	Front/rear cover (4U)
	Stacking foot
	Front handle kit (4U)
	Rack mount kit (4U)
Application equipment	
MH680A	Tracking Generator
MH648A	Pre-amplifier
MB23A	Portable Test Rack
MB24A	Portable Test Rack