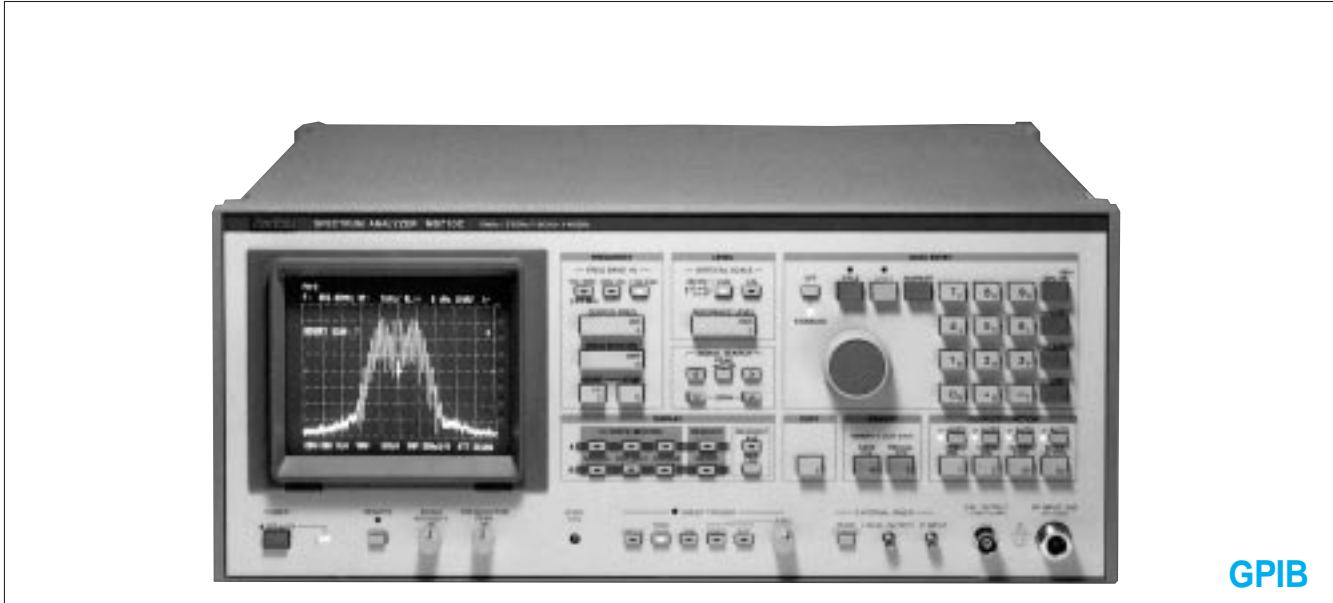


SPECTRUM ANALYZER
MS710C/D/E/F
 10 kHz to 23 GHz (18 to 140 GHz)

2



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

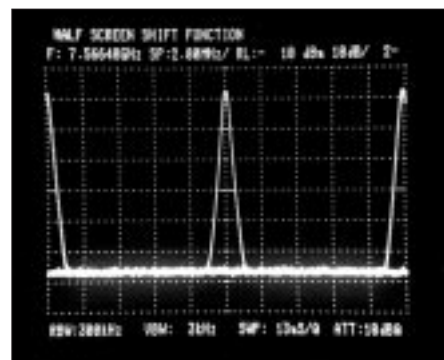
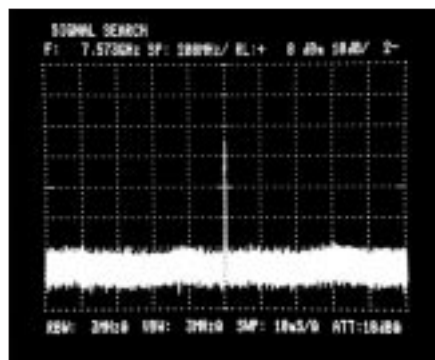
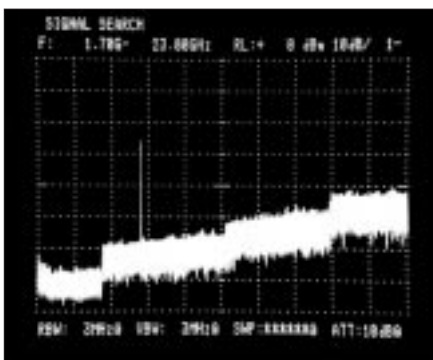
- Spectrum analysis of microwave devices and components
- Spurious emission and spectral distribution measurements of analog and digital communications transmitters
- Interference measurements for radio stations, satellite each stations, etc.
- Spectrum analysis in basic research such as nuclear physics 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.

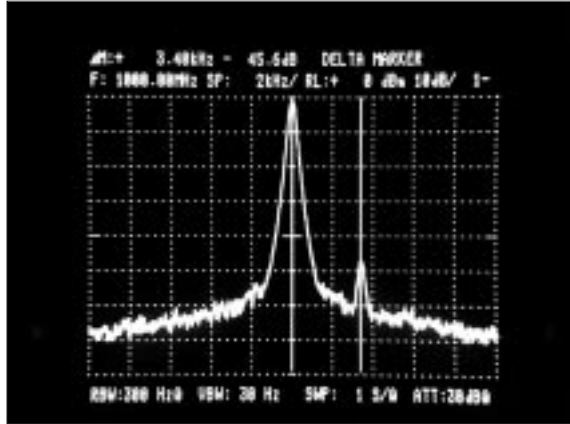
PEAK→CENTER

HALF SCREEN SHIFT



• **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.

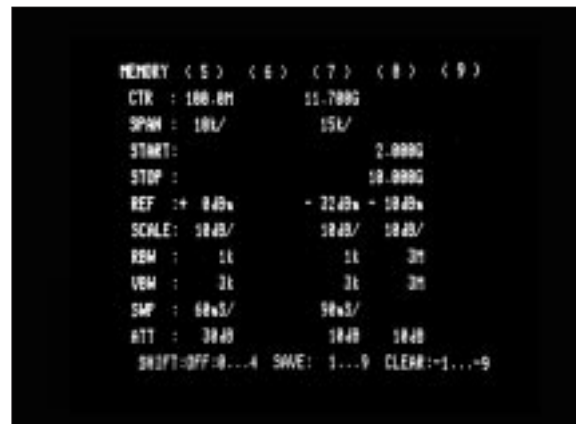


• **List display based on operability research**

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



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 | | |
| | Center frequency | Setting range | 0 MHz to 2 GHz, 1.7 to 23 GHz | |
| | | Readout resolution | 10 kHz (10 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) |
| | | Readout accuracy | ± (the following accuracy +2% of frequency span +10% of resolution bandwidth) | |
| | | | 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: ±5% (6 kHz/div to 200 MHz/div), ±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 ≥10 kHz) | In each band (span ≥1 MHz) |
| | | Readout resolution | Min. 10 kHz (various with span settings) (span = stop frequency – start frequency) | 1 MHz (span ≤200 MHz) 10 MHz (span ≤210 MHz) (span = stop frequency – start frequency) |
| | | Readout accuracy | ±(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: Selectable manually or automatically coupled to frequency span Selectivity (60 dB/3 dB): ≤10 : 1 (resolution bandwidth ≥1 kHz) | | | |
| Stability | Residual FM: ≤200 Hzp-p/0.1 s (center frequency; ≤6.5 GHz, span; ≤100 kHz/div) Noise sidebands: ≤-75 dB (1 kHz resolution bandwidth, 10 Hz video bandwidth, 30 kHz from signal, center frequency ≤6.5 GHz) | | | |
| Amplitude | Measuring range | Average noised level to +30 dBm | | |
| | Display | 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 | ±0.2 dB/1 dB, ±1.5 dB/70 dB | |
| | Reference level | Setting range: -109 to +30 dBm Calibration output accuracy: -10 dBm ±0.3 dB (100 MHz ±10 kHz) Reference level accuracy: ±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: ±1 dB (0 to 60 dB, 100 kHz to 2 GHz), ±2 dB (0 to 40 dB, 100 kHz to 23 GHz) Maximum accumulation error: ±2.2 dB (0 to 60 dB, 100 kHz to 2 GHz), ±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 ±2.5 dB (100 kHz start frequency, 10 MHz stop frequency) ±1.5 dB (10 MHz start frequency, 2 GHz stop frequency) ±2.5 dB (1.7 GHz start frequency, 5.48 GHz stop frequency) ±3 dB (5.48 GHz start frequency, 12.52 GHz stop frequency) ±4 dB (12.52 GHz start frequency, 23 GHz stop frequency) | | |

Continued on next page

| 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*(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*(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*(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 | |
| | Input | Connector: N-type (nominal 50 Ω) Maximum input level: +30 dBm, ±0 Vdc | |
| Marker | Normal | Frequency and level at marker displayed | |
| | Frequency readout resolution | 1/50 of span/div or 1 kHz whichever greater | 1/50 of span/div or 10 kHz whichever greater |
| | Level readout resolution | 1/100 of span/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 | | |
| CRT display | CRT Display area: 80 mm x 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→B, A↔B | | |
| Function setting memory | 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. | | |
| Display memory | Up to 9 sets of display (title, function settings, signal trace) can be saved or recalled. | | |
| Sweep | 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 μs/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 | | |
| Remote-control | 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. | | |
| Direct plotting | CRT information can be plotted by the specified plotter or printer | | |
| Power | AC 100 V ^{+10%} _{-15%} , 50/60 Hz, ≤200 VA | | |
| Dimensions and mass | 426 (W) x 177 (H) x 451 (D) 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) | 1 MHz |
| | | Readout accuracy | 30 kHz x harmonic number | 1 MHz x 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 x n/div to 200 kHz x n/div in 1 kHz x n increments 210 kHz x n/div to 2 MHz x n/div in 10 kHz x n increments 2.1 MHz x n/div to 20 MHz x n/div in 100 kHz x n increments 21 MHz x n/div to 200 MHz x n/div in 1 MHz x n increments For span up/down keys: 1 kHz x n/div to 200 MHz x n/div in 1 x n, 2 x n, 5 x n, 10 x n sequence (n: harmonic number) Readout accuracy: $\pm 5\%$ (6 kHz x n/div to 200 MHz x n/div), $\pm 10\%$ (1 kHz x n/div to 5 kHz x n/div) Setting: Number/unit keys, data knob, or span up/down keys | | |
| | Start/stop frequency | Setting range | In each band (span $\geq 10 \text{ kHz} \times n$) | In each band (span $\leq 1 \text{ MHz} \times n$) |
| | | Readout resolution | Min. 10 kHz x n (varies with span settings) Span = stop frequency – start frequency | 1 MHz (span $\leq 200 \text{ MHz} \times n$) 10 MHz (span $\leq 210 \text{ MHz} \times n$) Span = stop frequency – start frequency |
| | | Readout accuracy | $\pm(\text{center frequency accuracy} + 2.5\% \text{ of span})$ | |
| | | 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) | $\leq 10 : 1$ (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), -9.5 to +30 dBm (LIN) | |
| | | Calibration output accuracy | $-10 \text{ dBm} \pm 0.3 \text{ dB}$ (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 | | | |

Continued on next page

| Model | | MS710C | MS710D |
|--------|---------------------------------|--|--|
| Marker | Normal | Frequency and level at markers displayed | |
| | Frequency readout resolution | 1/50 of span/div or 1 kHz x n whichever greater | 1/50 of span/div or 10 kHz x 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 |

• 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 |
|-----------------|---|
| MS710C | Main frame Spectrum Analyzer (10 kHz to 23 GHz/18 to 140 GHz) |
| MS710D | |
| MS710E | |
| MS710F | |
| | 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 | MS710[] operation manual: 1 copy |
| W0087BE | MS710[] 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 (N-type connector, 10 W, DC to 18 GHz) |
| J0064A | Coaxial to 7 GHz band waveguide adaptor (5.8 to 8.6 GHz, BRJ-7 • N-J) |
| J0064C | Coaxial to 10 GHz band waveguide adaptor (8.2 to 12.4 GHz, BRJ-10 • N-J) |
| MP59B | Coaxial Switch (DC to 3 GHz) |
| J0114A | Coaxial cord, 1 m (N-P • RG-9A/U • N-P, general use) |
| DGM010-02000EE | Coaxial cord, 2 m (N-type connector, general use) |
| DGM024-02000EE | Coaxial cord, 2 m (N-type connector, low-loss type) |
| J0309 | Mixer cable, 1 m (HRM-202B • RG58A/U • HRM-202B) |
| J0004 | Coaxial adaptor (N-P • SMA-J) |
| J0007 | GPIB cable, 1 m |
| J0008 | GPIB cable, 2 m |
| J0409 | Centronics cable, 1 m (for printer) |
| J0410 | Centronics cable, 2 m (for printer) |
| B0115C | CRT hood |
| B0063 | Carrying case (for standard type) |
| B0020 | Front/rear cover (4U) |
| B0029 | Stacking foot |
| B0038 | Front handle kit (4U) |
| B0043 | Rack mount kit (4U) |
| | Application equipment |
| MH680A1 | Tracking Generator |
| MH648A | Pre-amplifier |
| MB23A | Portable Test Rack |
| MB24A | Portable Test Rack |



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