# ANRITSU

# MS 710
# SERIES

## SPECTRUM ANALYZER

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# SECTION 1

# GENERAL

The MS710 series Spectrum Analyzers are high-performance instruments that incorporate various advanced microwave and digital technologies using micro-processors. These spectrum analyzers are used for measuring a wide range of low to extremely high frequencies.

The major applications of this series include multiple testing for the development and production of high-frequency devices and components, analyzing spurious signals and spectrum distribution and the modulation characteristics of radio equipment, and monitoring spectrum and interference wave measurements at microwave radio stations (ground and satellite stations).

Digital memory and microprocessor control provides new functions (signal search, marker functions, measuring conditions and image data memory, and direct plotting) to facilitate simplified and effective manual measurements.
In addition to the above, remote control and data output via the GP-IB is possible thus enabling the MS710 series Spectrum Analyzer to be used to construct automatic measurement systems in combination with personal computers and other measuring instruments.

The MS710 series is comprised of the following four models so that customers can select instruments according to specific requirements.

| Model | Low frequency band: 10 kHz to 30 MHz | Standard frequency bands: 100 kHz to 2 GHz/1.7 to 23 GHz | External mixer bands: 18 to 140 GHz | Frequency accuracy (fundamental mixing mode) |
|---|---|---|---|---|
| MS710C | O | O | O | 30 kHz |
| MS710D | - | O | O | 1 MHz |
| MS710E | - | O | - | 30 kHz |
| MS710F | - | O | - | 1 MHz |

The above table shows that the MS710C is the top-of-the-line model; the other models are lower-level and are not equipped with all the MS710C functions.

This manual describes all the MS710C functions. Consequently, as noted in each section, some functions are not applicable to other models.

In this manual, the MS710C/D/E/F models are referred to as the MS710[ ].

SECTION 2

COMPOSITION AND SPECIFICATIONS

## 2.1 Composition

Table 2-1 Standard Composition

| Item | No. | Name | Qty. | Remarks |
|---|---|---|---|---|
| Equipment | 1 | MS710[ ] Spectrum Analyzer | 1 | |
| Accessories | 2 | Coaxial Cable | 1 | [BNC(P)] RG-55/U / 1 m [N(P)] |
| | 3 | Power cord | 1 | |
| | 4 | Fuse | 1 set | 2 A ---------- 1<br>1 A ---------- 1<br>1.6 A -------- 1<br>*** A -------- 2 |
| | 5 | Operation Manual | 1 | |
| | 6 | Service Manual | 1 | |

## 2.2 Specifications

Table 2-2 Specifications

### 1. Frequency

**1.1 Measuring range**

| Frequency band | N* | 1st IF Freq. | Remarks |
|---|---|---|---|
| 10 k – 30 MHz** | 1 | 521.4 MHz | |
| 100 k – 2 GHz | 1 | 2521.4 MHz | |
| 1.7 G – 23 GHz | 1 to 4 | 521.4 MHz | Note |
| 18 G – 26.5 GHz*** | 6 | 521.4 MHz | with EXT MIXER |
| 22 G – 33 GHz*** | 6 | 521.4 MHz | with EXT MIXER |
| 26.5 G – 40 GHz*** | 8 | 521.4 MHz | with EXT MIXER |
| 40 G – 60 GHz*** | 10 | 521.4 MHz | with EXT MIXER |
| 60 G – 90 GHz*** | 16 | 521.4 MHz | with EXT MIXER |
| 90 G – 140 GHz*** | 26 | 521.4 MHz | with EXT MIXER |

* N is the Harmonic Mixing Mode Number defined as follows

$f = N \times f_{LO} \pm f_{IF}$

f : Measuring Frequency    fLO : 1st Local Frequency

fIF : 1st IF Frequency

Note : N = 1 for f < 6.5 GHz, N = 2 for f <12.5 GHz
N = 3 for f <12.5 GHz, N = 4 for f >18.5 GHz

**1.2 Center frequency**

Setting range: 0 Hz to 140 GHz

Readout resolution:

| Freq. band | Readout resolution MS710C/E | Readout resolution MS710D/F |
|---|---|---|
| 10 k – 30 MHz** | 1 kHz | — |
| 100 k – 2 GHz | 10 kHz | 100 kHz |
| 1.7 G – 23 GHz | 10 kHz | 1 MHz |
| 18-26.5/22-33/*** 26.5-40 GHz*** | 100 kHz | 1 MHz |
| 40-60/60-90/90-140 GHz*** | 1 MHz | 1 MHz |

Readout accuracy: ±(following accuracy E + 20% of frequency span/DIV + 10% of resolution bandwidth)
E = 30 kHz x N(MS710C/E), 1 MHz x N(MS710D/F)
N: Harmonic mixing mode order number
E = 3 kHz (10 k – 30 MHz band only)

Setting: Number/unit keys, data-knob, peak center key, or half-screen shift key

**1.3 Frequency span**

Setting range and resolution: Following and 0 Hz (fixed tuning) in number/unit keys and following 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 MHz/div to 20 MHz/div in 100 kHz increments
21 MHz/div 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% (200 MHz/div to 6 kHz/div)
±10% (5 kHz/div to 1 kHz/div)

Setting: Number/unit keys, data knob, or span up/down keys

**: MS710C only    ***: MS710C/D only

Table 2-2 (Continued)

| | | |
|---|---|---|
| 1. Frequency (cont.) | | |
| 1.4 Start frequency/ Stop frequency | Setting range | Same as Center frequency (stop frequency > start frequency) |
| | Readout resolution | Minimum 10 kHz (MS710C/E), 1 MHz (MS710D/F) Depends on the Span (Span = Stop frequency - Start frequency) |
| | Readout accuracy | ±(Center frequency accuracy + 2.5% of span) |
| | Setting | Number/unit keys or data knob |
| 1.5 Marker | Normal | Frequency of the marker position displayed. |
| | Δ(delta) | Frequency difference between two marker positions displayed. |
| | Peak | Marker shows Peak Position and frequency displayed. |
| | MKR-CF | Marker frequency set to center frequency. |
| 1.6 Resolution | | |
| Resolution bandwidth (6 dB bandwidth) | Setting range | 100 Hz to 3 MHz in a 1, 3, 10 sequence |
| | Setting | May be selected manually or automatically coupled to frequency span. |
| Selectivity (60 dB/6 dB) | ≦10 : 1 | |
| 1.7 Stability (for fundamental mixing; center frequency ≦6.5 GHz) | | |
| | Drift (typical) | 30 kHz/1 H (initial), 2 kHz/10 min (after 1.5 hours warm-up) |
| | Residual FM | ≦100 Hzpp/0.1 s (Span ≦50 kHz/div, 10 k - 30 MHz Band) ≦200 Hzpp/0.1 s (Span ≦100 kHz/div, other Bands) |
| | Noise sidebands | ≦-75 dB (1 kHz resolution bandwidth, 10 Hz video bandwidth, 30 kHz from signal) |

Table 2-2 (Continued)

| | | |
|---|---|---|
| 2. Amplitude | | |
| 2.1 Measuring range | Average noise level to +30 dBm | |
| 2.2 Display | | |
| Graticule | Vertical 8 division, reference level 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 | |
| 2.3 Reference level | | |
| Setting range | -109 dBm to +30 dBm | |
| Calibration output accuracy | -10 dBm ±0.3 dB (100 MHz ±10 kHz) | |
| Reference level accuracy | ±2.0 dB (Reference level -99 dBm to -10 dBm, frequency 100 MHz, 0 dB input attenuator, after calibration using CAL OUTPUT) | |
| Input attenuator accuracy | Setting range | 0 dB to 70 dB, 10 dB step<br>Manual or automatic coupling to reference level can be selected |
| | Error between steps | ±1 dB (0 dB to 60 dB, 10 kHz to 2 GHz)<br>±2 dB (0 dB to 40 dB, 10 kHz to 23 GHz) |
| | Error of maximum accumulation | ±2.2 dB (0 dB to 60 dB, 10 kHz to 2 GHz)<br>±3 dB (0 dB to 40 dB, 10 kHz to 23 GHz) |
| Frequency response | With 10 dB input attenuator, and Preselector tuned to maximum response by peaking adjustment.<br>±1.5 dB (10 kHz start frequency, 30 MHz stop frequency) ..... 10 kHz to 30 MHz band<br>±2.5 dB (100 kHz start frequency, 10 MHz stop frequency)<br>±1.5 dB (10 MHz start frequency, 2 GHz stop frequency) ...... 100 kHz to 2 GHz band<br>±2.5 dB (1.7 GHz start frequency, 5.478 GHz stop frequency)<br>±3 dB (5.478 GHz start frequency, 12.521 GHz stop frequency)<br>±4 dB (12.521 GHz start frequency, 23 GHz stop frequency) ..... 1.7 GHz to 23 GHz band | |

Table 2-2 (Continued)

| | | | |
|---|---|---|---|
| 2. Amplitude (cont.) | | | |
| 2.4 Marker | | | |
| | Normal | Level of the marker position displayed. | |
| | Δ(delta) | Level difference between two marker positions displayed. | |
| | Peak | Marker shows peak position and level. | |
| 2.5 Dynamic range | | | |
| 2nd harmonic distortion | Input frequency | Value obtained by subtracting input attenuator value from input level | 2nd harmonic distortion |
| | 10 kHz to 300 kHz<br>300 kHz to 15 MHz<br>(10 kHz to 30 MHz band) | -40 dBm<br>-40 dBm | ≦ -60 dB<br>≦ -70 dB |
| | 100 kHz to 10 MHz<br>10 MHz to 200 MHz<br>200 MHz to 850 MHz<br>(100 kHz to 2 GHz band) | -40 dBm<br>-30 dBm<br>-30 dBm | ≦ -60 dB<br>≦ -70 dB<br>≦ -80 dB |
| | 850 MHz to 11.5 GHz<br>(1.7 GHz to 23 GHz band) | -10 dBm | ≦ -100 dB* |
| Two-signal 3rd intermodulation distortion | Input frequency | Frequency difference of two input signals/ Value obtained by subtracting input attenuator value from input total level | Two signals 3rd intermodulation distortion |
| | 10 kHz to 30 MHz | ≧50 kHz/-40 dBm | ≦ -70 dB |
| | 100 kHz to 2 GHz | ≧2.5 MHz/-30 dBm | ≦ -80 dB |
| | 1.7 GHz to 12.5 GHz | ≧70 MHz/-10 dBm | ≦ -100 dB* |
| | 12.5 GHz to 23 GHz | ≧100 MHz/-10 dBm | ≦ -100 dB* |
| 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)<br>≦ -115 dBm (1 MHz to 2 GHz)<br>≦ -110 dBm (1.7 GHz to 6.5 GHz)<br>≦ -100 dBm (6.5 GHz to 12.5 GHz)<br>≦ -95 dBm (12.5 GHz to 18.5 GHz)<br>≦ -88 dBm (18.5 GHz to 23 GHz)<br>1 kHz resolution bandwidth, 0 dB input attenuator, and 3 Hz video bandwidth | | |

* Less than specified level or average noise level

Table 2-2 (Continued)

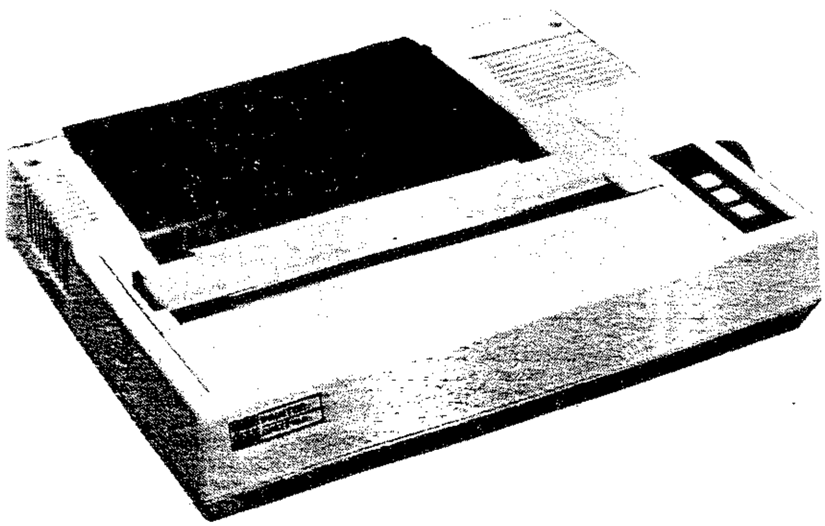
| | | |
|---|---|---|
| 2. Amplitude (cont.) | | |
| 2.6 Video bandwidth | 1 Hz to 3 MHz, 1, 3, 10 sequence<br>Manual or automatic coupling to frequency span can be selected | |
| 2.7 Input | | |
| Connector | N-type (nominal 50 Ω) | |
| Maximum input level | +30 dBm, dc ±0 V | |
| 3. CRT display | | |
| 3.1 CRT | Display area | 80 H x 100 W mm |
| | Display item | Graticule, signal traces, function setting value, error message, and title |
| 3.2 Signal traces | | |
| Memory capacity | Horizontal 501 points, vertical 801 points, A and B channels, backed-up by battery | |
| Display | NORMAL, MAX HOLD, AVERAGE, A channel-B channel | |
| 4. Function setting memory | Up to 10 sets of each function setting value saved and recalled. Memory list displayed on CRT, backed up by battery. | |
| 5. Sweep | | |
| 5.1 Sweep time | 2 ms/div to 10 s/div. Manual or automatic coupling to frequency span, resolution bandwidth, and video bandwidth can be selected<br>For 0 Hz frequency span, 2 µs/div to 10 s/div with manual setting.<br>When span ≧2.01 GHz, previously given time set, time not manually settable. | |
| 5.2 Trigger | Single, free run, line, video, and external trigger | |
| 6. Remote control | GP-IB (IEEE488, IEC625-1, 24 pins) All front panel functions (except power switch, CRT intensity, frequency calibration, level calibration, and trigger level adjustment knob) remote-controlled. | |
| 7. Direct plotting | CRT information plotted by specified plotter or printer | |
| 8. Power | ** Vac$^{+10}_{-15}$%, 50/60 Hz, ≦200 VA | |
| 9. Dimensions and weight | 177 H x 426 W x 451 D mm ≦27 kg | |

## 2.3 Application Equipment

For wider application of the MS710[ ], the following application equipments are available. Note that these equipments must be ordered separately.

### 2.3.1 DPR7713A Printer

This printer enables printing of high-resolution bit images. Hard copies of screen images can be made quickly and easily by connecting it to the MS710[ ]. Since a GP-IB function is provided, the printer can also be used as an output device for an automatic measuring system.



### 2.3.2 MH672A and MH680A Tracking Generators

These tracking generators are used in conjunction with the MS710[ ] as swept signal generators for direct measurement of the frequency response. They can also be used as a level-calibrated signal source because the output level is accurately controlled by a high-performance ALC circuit.

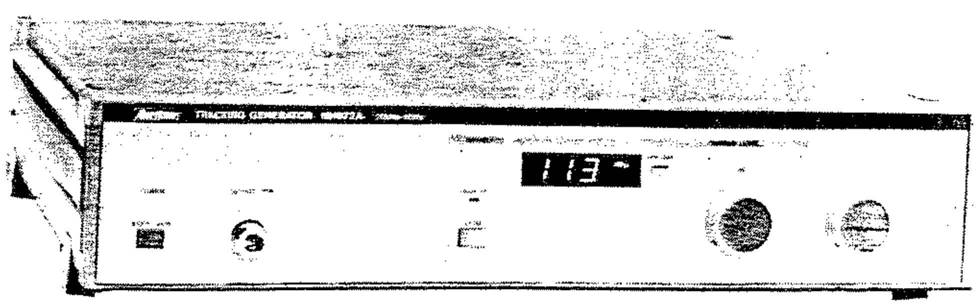
The average or normalize (A-B) function of the MS710C is available with these tracking generators.

- MH672A Tracking Generator

| | |
|---|---|
| Frequency Range: | 20 kHz to 2 GHz* |
| Output Level: | 0 to -59 dBm / 1 dB Steps<br>Accuracy ±0.4 dB |
| GP-IB: | Programmable output level |

- MH680A Tracking Generator

| | |
|---|---|
| Frequency Range: | 100 kHz to 2 GHz* |
| Output Level: | -10 to 0 dBm Continuous<br>Accuracy ±0.5 dB at 0 dBm |

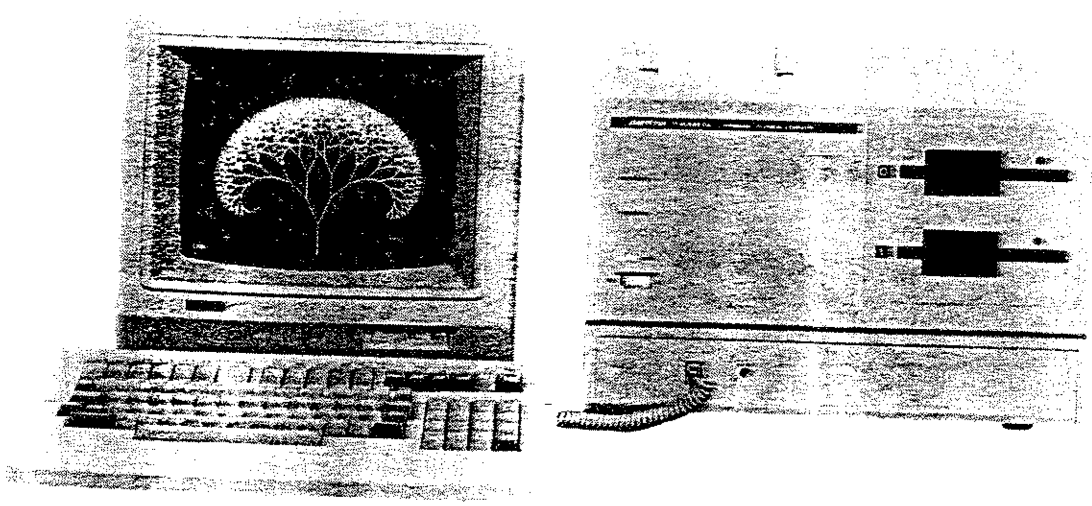


MH672A

* These tracking generators can be used in the 100 kHz to 2 GHz band of the MS710[ ].

2.3.3 Packet III/IIIs Personal Technical Computer

This is a high-speed control and technical calculation personal computer which uses ANSI-expanded BASIC based on FDOS. It is equipped with a highly-efficient, MC68000 16-bit microprocessor. Commands for easy measurement control using the GP-IB are provided and the Packet III/IIIs forms a suitable system controller when configured with the MS710[ ].



Packet IIIs

2.3.4 MB23A and MB24A Portable Test Racks

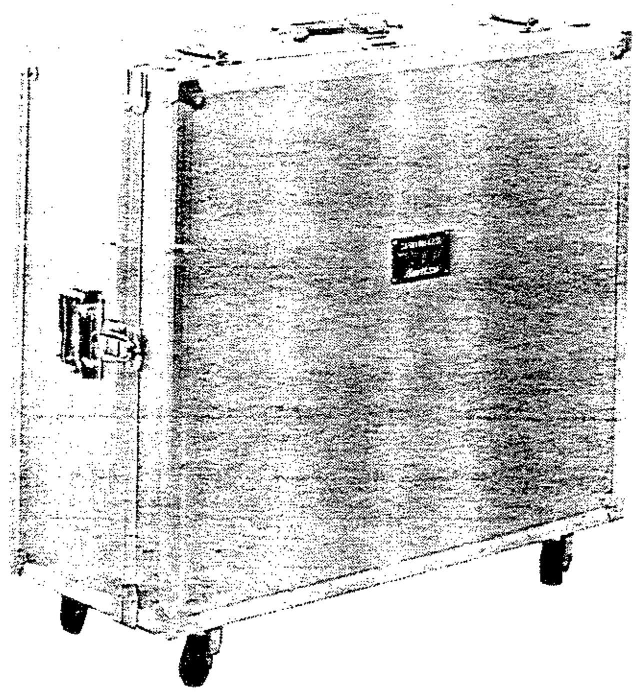
These portable, foldable test racks can be used to easily move measuring equipment, including the MS710[ ]. The MB23A rack can be set to five different inclined positions to facilitate instrument reading and can carry up to 40 kg.

The MB24A can carry up to 100 kg, and can be used to hold a combined system. The rack table is fixed in a horizontal position.

(MB23A)

2.3.5 Carrying case

This carrying case is covered with aluminum, and has castor wheels for easy transportation. It is ideal for transporting the MS710[ ] by car or plane for long distances.



SECTION 3

OPERATION

This section explains operation of the MS710[ ]. The MS710[ ] automatically changes measurement parameters or issues an alarm in response to illegal commands. It also has new functions which simplify and speed-up measurement. These special operations are explained in this section.

Operators familiar with a spectrum analyzer will be able to operate the MS710[ ] after reading only this section.

Details on the operations of panel controls are given in Section 4. Refer to them as required.

Square bracket items such as [CENTER FREQ] #4 [1] [0] [0] [MHz] indicate key operations.

CAUTION

1. Ground the terminal on the rear panel to avoid electric shock.
2. Ensure the POWER switch is off and power supply cord unplugged whenever replacing fuses.

## 3.1 Handling Precautions

(1) Power supply

The MS710[ ] operates on ** Vac $^{+10}_{-15}$%, 48 to 63 Hz line supply, as indicated on the rear panel.

When changing the nominal ac line voltage, change the settings of the line voltage selection switches S2 and S3 according to the following instructions.

| Step | Procedure |
|---|---|
| 1 | Turn off the POWER switch and disconnect the power supply cord from the ac outlet. |
| 2 | Remove the top cover as follows:<br>(a) Use a screwdriver to open the screw covers on each end of the handle at the center of the side cover #1.<br>(b) Remove the handle #2 by removing the screws #3 under the screw cover.<br>(c) Remove the side cover #1 by removing the four screws #4 at the corners of the side cover. |

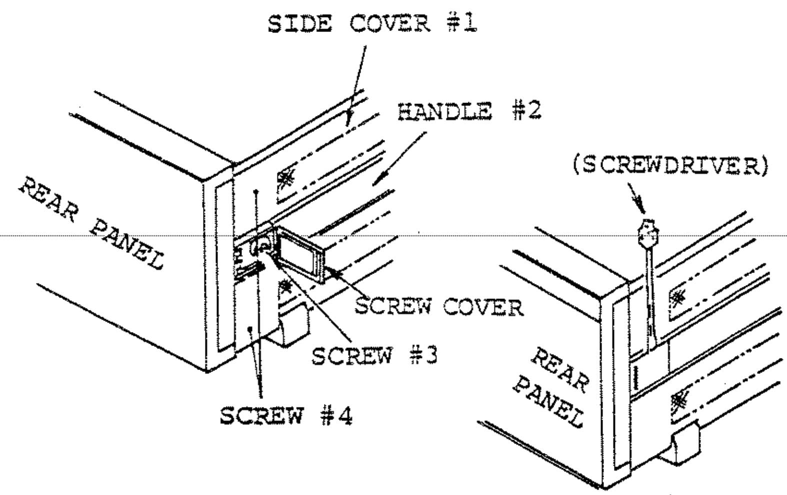
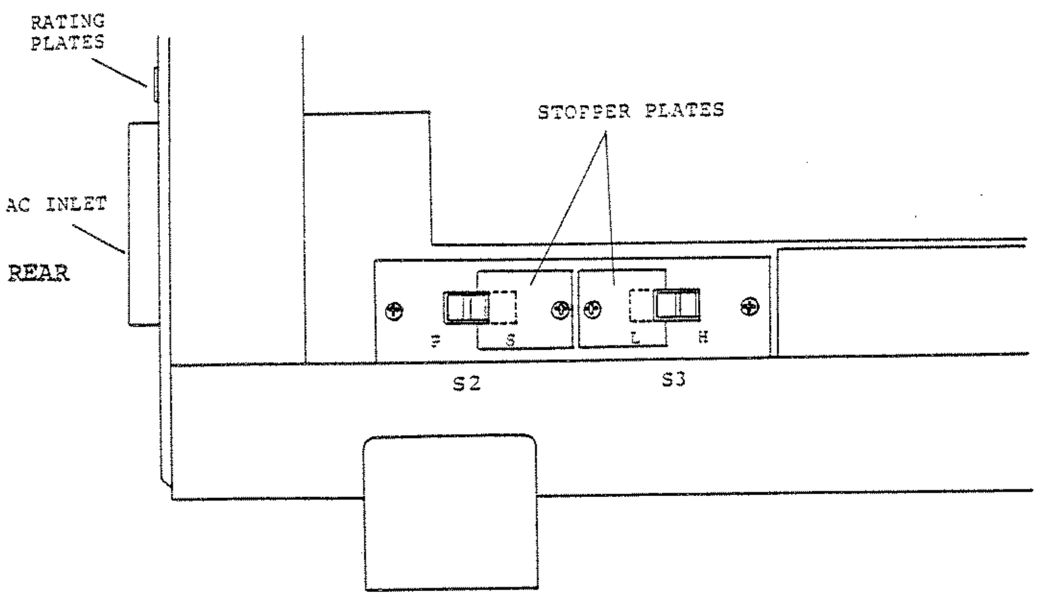



Fig. 3-1 Side Cover Removal

| Step | Procedure |
|---|---|
| 3 | Remove the stoppers and set the switches to the desired positions. |

| Step | Procedure |
|---|---|

| Nominal ac Line Voltage | Switch Position S2 | Switch Position S3 |
|---|---|---|
| 100 to 113 V | P ■□ S | L ■□ H |
| 114 to 127 V | P ■□ S | L □■ H |
| 200 to 226 V | P □■ S | L ■□ H |
| 227 to 254 V | P □■ S | L □■ H |




Left Side View (top cover is removed)

4 Reassemble the switch stoppers and the left side cover.

5 Change the voltage and current rating plates on the rear panel to the appropriate ones.

(The plates can be ordered from Anritsu.)

(2) Operating and storage conditions

The MS710[ ] is designed to operate normally in an ambient temperature range of 0° to 50°C. For best operation however, it should be used at normal room temperature whenever possible. Do not use or store the instrument in locations where

1. vibrations are severe
2. it is damp or dusty
3. there is exposure to direct sunlight
4. there is exposure to active gases
5. there is exposure to strong magnetic fields
6. oxidation or rusting may occur.

If this instrument is operated at room temperature after being used or stored for a long period at low temperatures, condensation may occur and cause short-circuiting. To prevent this do not turn the power on until the instrument is completely dry.

(3) Maximum input level

Input exceeding +30 dBm may damage the internal circuitry.

## 3.2 Panel Control Functions

Front- and rear-panel illustrations (see Figs. 3-2(a) and (b)) are located at the back of this manual. Control descriptions are indexed to the panel.

Table 3-1 gives overall descriptions of the control functions.

See SECTION 4 for detailed descriptions of the Control Functions.

Table 3-1 Panel Control Functions

| Section Name | Label | Explanation |
|---|---|---|
| FREQUENCY #1 | This section consists of functions related to frequency measurement. | |
| | FREQ BAND 100 k-2G #2 | Selects 100 kHz to 2 GHz frequency band. Press to initialize band. |
| | FREQ BAND 1.7G-23G #3 | Selects 1.7 to 23 GHz frequency band. Press to initialize band. Band consists of four automatically selected frequency ranges. |
| | FREQ BAND 10 k-30M EXT MIX #55 (MS710C/D only) | Selects one of six external mixer bands and 10 kHz to 30 MHz frequency band. When pressed, available frequency band list displayed on CRT. Press appropriate number key, to select desired frequency band. |
| | CENTER FREQ MKR #4 | Sets frequency value in central position of CRT horizontal axis as center frequency. Used with MARKER #20, to actuate Normal Marker. |
| | FREQ SPAN /DIV ΔMKR #5 | Determines sweep frequency range on CRT horizontal axis as frequency span per division divided by 10. Used with MARKER #20, to actuate Delta Marker. |
| | START P.P. #6 | Places starting frequency of frequency sweep at left graticule field. Used with SHIFT #19, to start automatic preselector tuning. |
| | STOP #7 | Places end frequency of frequency sweep at right graticule field. |
| LEVEL #8 | This section includes functions related to level measurement. | |
| | VERTICAL SCALE LOG #9 | Selects scale on CRT vertical axis as logarithmic amplitude scale. Each time when this key is pressed, the scale changes cyclically 10 dB/, 5 dB/, 2 dB/ and 1 dB/. |

Table 3-1 (Continued)

| Section Name | Label | Explanation |
|---|---|---|
| LEVEL #8 (cont.) | VERTICAL SCALE LIN #10 | Selects scale on CRT vertical axis as a linear amplitude scale. |
| | REFERENCE LEVEL PMKR #11 | Specifies signal level at top graticule line of scale on CRT. Used with MARKER #20, to actuate Peak Marker. |
| SIGNAL SEARCH | This section includes functions for quick search of desired signals. | |
| | PEAK → CTR #12 | Sets highest level frequency on CRT to center frequency. Does not operate in STORE mode display and READ OUT A-B mode display. Works with MARKER #20, as Marker → CRT key. |
| | ≪, ≫ #13 | Shifts display on CRT by half the screen to left or right. Does not operate in Start-Stop frequency sweep mode. |
| | SPAN ⩔, ⩓ #14 | Increases or decreases frequency span data in 1, 2, 5, 10 sequence. Does not operate in Start-Stop frequency sweep mode. |
| DATA ENTRY #15 | This section includes functions to input the data for measurement condition setting. | |
| | OFF #16 | When pressed while ENABLED #17 LED ON, next data, input by data knob #23 and number key #21, invalidated. With MARKER #20, Marker display turned off. |
| | ENABLED #17 | When one from FREQUENCY, LEVEL, MARKER or COUPLED FUNCTION keys pressed, LED lights and measuring data can be input. |

Table 3-1 (Continued)

| Section Name | Label | Explanation |
|---|---|---|
| DATA ENTRY #15 (cont.) | TITLE #18 | Used to display alphanumeric characters on top field of CRT. Pressing this key, enables input of characters on keytops. |
| | SHIFT #19 | Changes display character types between alphabet and numeric when using TITLE #18. Also used for special functions listed in paragraph 4.3.6. |
| | MARKER #20 | Starts selection of Marker function. When pressed, marker function list displayed on CRT. Press an appropriate key to activate selected marker function. |
| | Number keys #21 | Used when numeric value input. Maximum seven digits. |
| | Unit keys #22 | After numeric value input with Number keys #21, determines unit and ends data entry. |
| | Data knob #23 | Changes data continuously without pressing unit key. |
| COUPLED FUNCTION #24 | In AUTO, each of these four functions operates interrelatedly according to the current measurement conditions. | |
| | AUTO #25 | In AUTO, each of these four functions automatically set to most appropriate measurement condition. At span 0 Hz, AUTO mode released and manual operation necessary. |
| | INPUT ATTEN #26 | Sets attenuation of input attenuator from 0 to 70 dBm in 10 dB steps. |
| | SWEEP TIME #27 | Determines sweep time between 2 µs/div and 10 s/div. In start-stop frequency sweep mode greater than 2 GHz, becomes AUTO and "******@" displayed on CRT. |

Table 3-1 (Continued)

| Section Name | Label | | Explanation |
|---|---|---|---|
| COUPLED FUNCTION #24 (cont.) | VIDEO BW #28 | | Determines postdetection noise filter bandwidth between 1 Hz and 3 MHz. |
| | RES BW #29 | | Determines resolution bandwidth of IF Filter between 100 Hz and 3 MHz. |
| MEMORY #32 | Saves or Recalls measurement conditions to or from internal memory. | | |
| | RECALL #33 | | Displays all parameters stored in memories (0 to 9). By selecting one of memory addresses, selected memory contents set to current measurement conditions. |
| | SAVE #34 | | Displays all parameters in memories (0 to 9). By selecting one of memory'addresses, current measurement condition stored in selected memory. Minus addresses (-1 to -9) clear memory contents. Address 0 memory stores last condition without key operation for convenience. |
| COPY | COPY #35 | | Makes copy of CRT display at plotter or printer. With SHIFT off, copies all display. With SHIFT on, copies only signal traces and graticule. Press key again to stop copy. |
| DISPLAY #43 | This section includes the selection switches for processing A/D converted waveform data. (Not usable in fast sweep mode (2 µs/div to 1 ms/div).) | | |
| | READ-OUT | A-B #44 | Subtracts contents of waveform memory B from waveform memory A and result displayed. A and B read-out turn-off automatically. |
| | | REF LINE #45 | Sets reference line (where difference zero) of result of subtraction A-B to top (TP), middle (MD), or bottom (BT) of vertical scale line. |

Table 3-1 (Continued)

| Section Name | Label | | Explanation |
|---|---|---|---|
| DISPLAY #43 (cont.) | | ON/ OFF #46 | Determines waveform memories A and B for displayed on CRT. (A-B) read-out turns off automatically. |
| | WRITE/ STORE | Either A or B in WRITE mode. A/D converted waveform data stored to either A or B on NORMAL, MAX HOLD, or AVERAGE mode, and displayed simultaneously. Other memory in STORE mode. B memory backed-up against turning ac power ON to OFF. | |
| | | AVERAGE #47 | Writes average value of data obtained with each sweep in waveform memory. |
| | | MAX HOLD #48 | Writes only maximum value of data obtained with each sweep in waveform memory. |
| | | NORMAL #49 | Writes sampled data in waveform memory. |
| SWEEP TRIGGER #36 | This section includes switches to select one of five sweep trigger modes and one trigger level control knob. | | |
| | LEVEL #37 | | Determines level (+0.5 to +5 V) triggered when VIDEO #39 or EXT #38 selected for triggering condition. |
| | EXT #38 | | Applies an external trigger signal to EXT TRIGGER INPUT #57. |
| | VIDEO #39 | | Starts sweep when internal video signal passes level set by LEVEL #37. |
| | LINE #40 | | Synchronizes triggering with ac line frequency. |

Table 3-1 (Continued)

| Section Name | Label | Explanation |
|---|---|---|
| SWEEP TRIGGER #36 (cont.) | FREE RUN #41 | Repeats free-running sweep according to timing set internally. |
| | SINGLE #42 | Starts sweep once with each press. |
| EXTERNAL #56 | MIXER | This section is used with external mixers. |
| | IF INPUT #57 | Input terminal for IF signal from 3 port type external mixer. |
| (MS710C/D only) | LOCAL OUTPUT #58 | Output terminal of local signal for external mixers. For 2-port type external mixer, also works as simultaneous input terminal for IF signal. |
| | MODE CHANGE #59 | Changes mixing mode to other mode (upper local to lower local and vice versa). Used to identify true signal in external mixer band. |
| | RF INPUT #30 | Input terminal for signal under measurement. |
| | CAL OUTPUT #31 | Standard signal output terminal for self calibration (-10 dBm, 100 MHz). |
| Other sections on the Front Panel | PRESELECTOR PEAK #50 | Fine-adjusts frequency of input signal preselector so that receiving (display) level at maximum in 1.7 to 23 GHz band. Auto-tuning done with [SHIFT] + [START] at span less than 50 MHz/div. Normally set in range of ⌒ mark. |
| | LEVEL CAL #51 | Fine-adjusts displayed trace of input signal up and down for calibration. |

Table 3-1 (Continued)

| Section Name | Label | Explanation |
|---|---|---|
| Other sections on the Front Panel (cont.) | SCALE INTENSITY #52 | Adjusts brightness of parameter and scale on CRT. (Brightness of signal waveform adjusted with TRACE INTENSITY #68.) |
| | LOCAL #53 | Changes remote control to local control when the GP-IB used. |
| | POWER #54 | Power supply switch. |
| Rear Panel | IF OUTPUT 21.4 MHz #60 | Signal output connector for 21.4 MHz IF section. |
| | EXT TRIGGER INPUT #61 | External trigger input connector. Trigger level variable from +1 to +5 V by LEVEL #37 on front panel. |
| | 1st LOCAL OUTPUT 2.2-6 GHz #62 | 1st LOCAL output connector. Used for tracking generator |
| | VIDEO OUTPUT #63 | Detected video signal output connector, 0 to +4 V. |
| | SWEEP OUTPUT #64 | Sweep signal output connector. 0 V to +4 V ramp signal. |
| | PEN LEFT #65 | Connector for signal for lifting pen when connected to X-Y recorder, and for blanking display when connected to external CRT. 0 V for pen down or non-blanking. +15 V for pen up or blanking. |
| | TRACE ROTATION #66 | Adjusts angle of trace on CRT. |
| | FOCUS #67 | Adjusts focus of trace on CRT. |

Table 3-1 (Continued)

| Section Name | Label | Explanation |
|---|---|---|
| Rear Panel (cont.) | TRACE INTENSITY #68 | Adjusts brightness of waveform data on CRT. (Brightness of parameter and scale adjusted by SCALE INTENSITY #52.) |
| | #69 | Ac inlet with fuses, for power cord connection. Ensure power switch OFF and power cord unplugged whenever replacing fuses. |
| | #70 | Ground terminal. To avoid electric shock, ground terminal. |
| | #71 | Selection switch for GP-IB address, plotter, printer, parallel interface, and copying operations. |
| | PARALLEL INTERFACE #72 | Parallel interface connector. Set selection switch #67. |
| | GP-IB #73 | GP-IB connector. Set selection switch #67. |
| | 2nd LOCAL OUTPUT 2.5 GHz #74 | 2ns LOCAL output connector. Used for tracking generator. |
| | PROBE POWER #75 | Power supply for active high impedance probe. Compatible with TEKTRONICS-type probe. |

## 3.3 CRT Display

The MS710[ ] displays all measurement parameters on the CRT. The following two figures show examples of the CRT display.

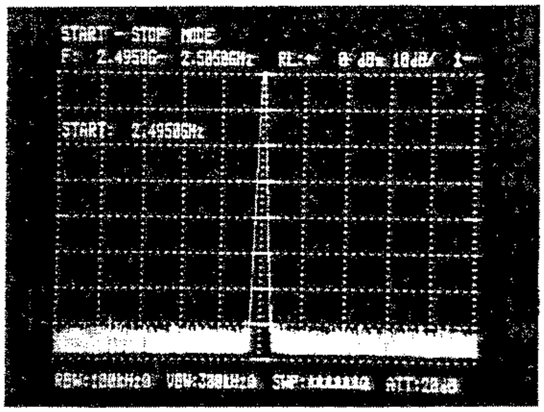



Fig. 3-3 CRT DISPLAY 1
Start-Stop,
Setting Mode

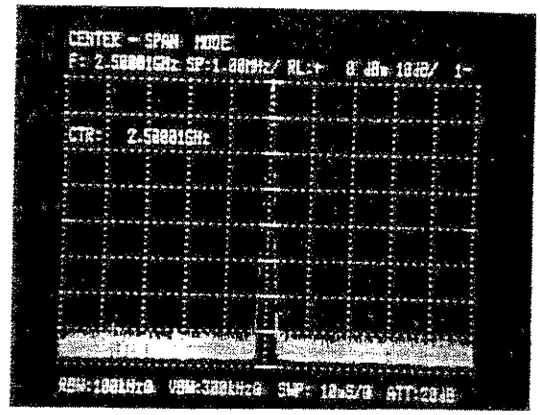



Fig. 3-4 CRT DISPLAY 2
Center-Span
Setting Mode

CRT abbreviations are explained below;

F: Start frequency on left side,
stop frequency on right side or center frequency

SP: Frequency span/div

RL: Reference level

MD: Middle (only when A-B activated.)

TP: Top (only when A-B activated.)

BT: Bottom (only when A-B activated.)

RBW: Resolution bandwidth

VBW: Video bandwidth

SWP: Sweep time

ATT: Input attenuation

## 3.4 Inputting Measurement Conditions

### 3.4.1 Data entry start

Setting the measurement parameter is started by either pressing the FREQUENCY, LEVEL, or the coupled function keys (RES BW, VIDEO BW, SWEEP TIME, and INPUT ATTEN). The function name that can be set and the currently set value are displayed on the CRT. The "ENABLED" LED #17 also lights to indicate that setting is ready. In this "ENABLED" #17 condition, data can be input by number key #21 or data knob #23.

### 3.4.2 Number/unit keys input

Input by number keys #21 is terminated by pressing the unit key #22 for that function. Several units are indicated on a unit key, but the MS710[ ] selects only the unit corresponding to the function. However, if the corresponding unit is not able to make the selection, the MS710[ ] ignores that data and unit and displays the ignored data and unit as a frequency unit on the CRT. When data outside of the function range are input, the MS710[ ] ignores that input and displays the allowable setting range for that function.

### 3.4.3 Data knob input

Data, input by data knob #23, are increased by turning the knob clockwise and decreased by turning it counterclockwise. At this time, the unit key #22 input is not required. The step size of the data knob depends on each function.

### 3.4.4 Data input inhibition

When the data are set and the function value no longer need be changed, press [OFF] #16 to terminate data setting. When this key is pressed, the "ENABLED" LED #17 goes off. Any subsequent input by number key #21 or data knob #23 is ignored.

### 3.4.5 Automatic settings

To prevent the setting of illegal conditions due to incorrect combinations of functions or data conditions during operation, the MS710[ ]:

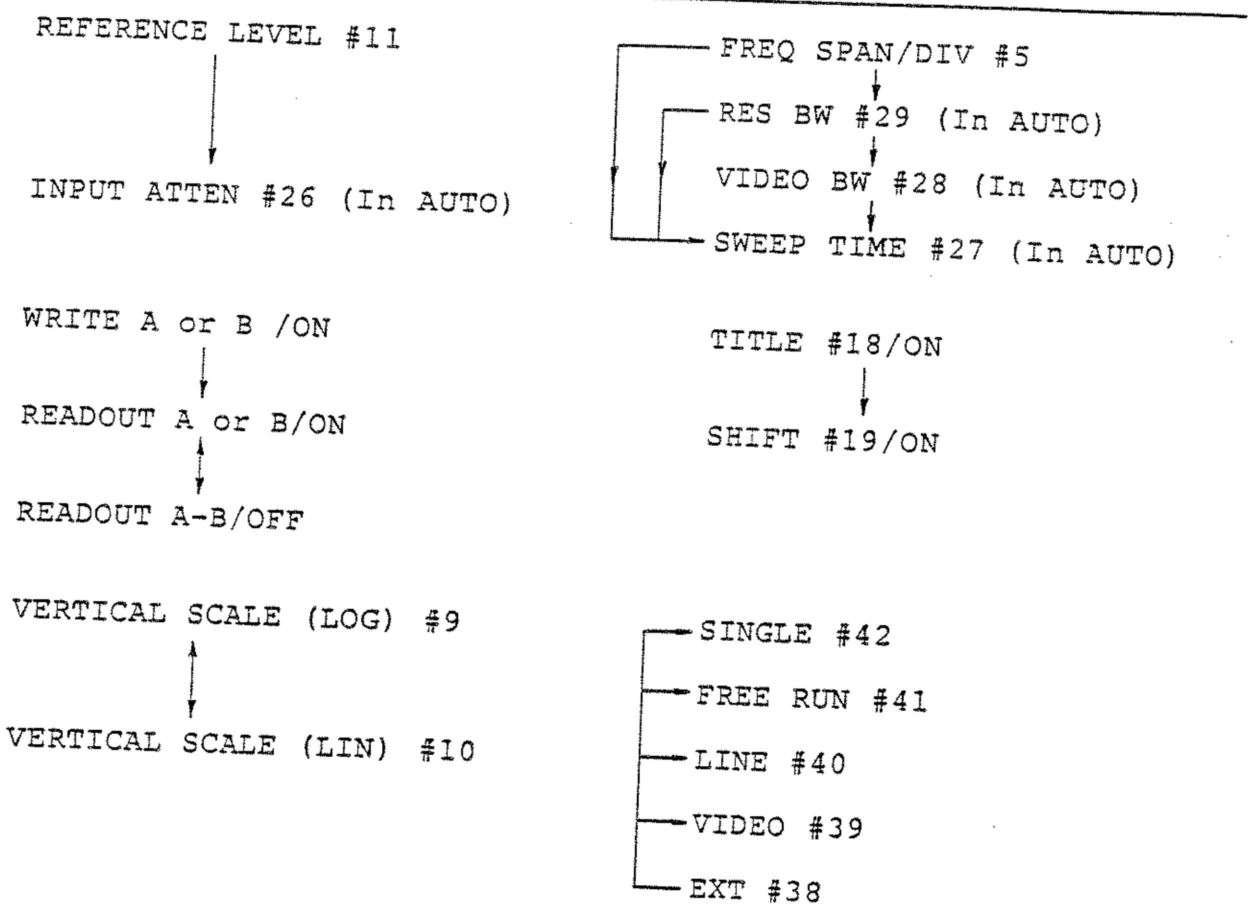
1. Gives priority to the input and changes the other parameters or

2. Ignores the input or keeps it within established limits.

The MS710[ ] only automatically changes other parameters, when the functions are in "AUTO" condition. Keys for such operations and the keys that operate together are shown in Table 3-2.

Table 3-2 Keys Which Change other Function Settings

(Changes in direction of arrows)



## 3.5 Self Calibration Procedure

To obtain the measurement accuracy given in the specifications in paragraph 2.2, the MS710[ ] must be calibrated using its built-in calibrating signal. The self calibration procedure is described below.

**CAUTION**

Before turning on the power, ensure that the ac line voltage is within the range described in paragraph 3.1.

| Step | Procedure |
|---|---|
| 1 | Turn on the power switch.<br><br>When power is turned on, a display similar to Fig. 3-5 appears on the CRT. This indicates that the entire band area between 1.7 and 23 GHz has been swept. The noise level increases in steps to the upper right because the conversion loss due to internal higher order mixing* has been corrected. Allow the instrument to warm-up for at least 30 minutes so the internal temperature stabilizes.<br><br>* See Section 6, Principles of Operation. |

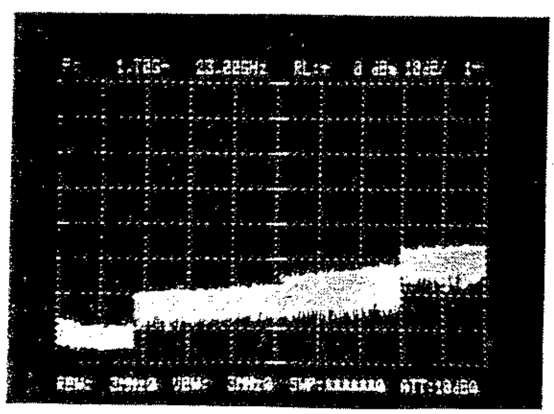


Fig. 3-5 Post power-on Display

| Step | Procedure |
|---|---|
| 2 | Press FREQ BAND [100K-2G] #2. |
| | The sweep frequency range becomes 0.0 MHz to 2000.0 MHz. In this condition, one division of the horizontal axis is 200 MHz, and that of the vertical axis is 10 dB with the highest scale level (reference level) as 0 dBm. |
| | All the COUPLED FUNCTIONs #24 are in AUTO and need not be changed. |
| 3 | Connect CAL OUTPUT #31 and RF INPUT #30. |
| | When CAL OUTPUT #31 is connected to RF INPUT #30 by the supplied coaxial cable, a signal is seen at a frequency of approximately 100 MHz on the horizontal scale as shown in Fig. 3-6. The signal level should be about one scale below the top horizontal line. |

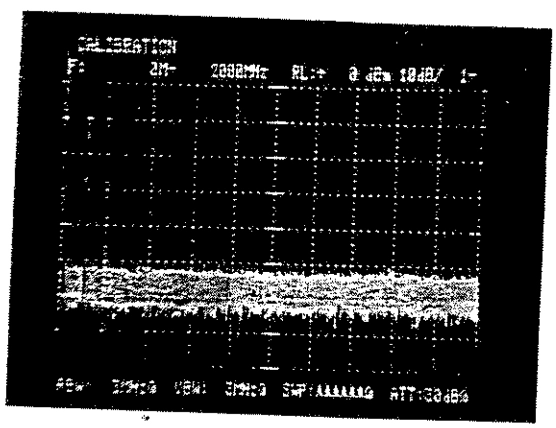



Fig. 3-6 Calibration Signal

| Step | Procedure |
|---|---|
| 4 | Press [CENTER FREQ] #4 [1] [0] [0] [MHz] |

This operation sets the center of the scale to 100 MHz. Note that the signal which appeared on the left side of the screen in Step 3 has moved to the center of the screen. (See Fig. 3-7.)

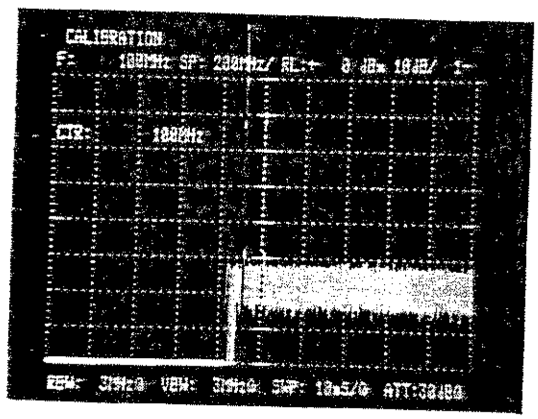



Fig. 3-7 Center Frequency Setting

| Step | Procedure |
|---|---|
| 5 | Press [FREQ SPAN/DIV] #5 [1] [MHz]. |

"FREQ SPAN/DIV" indicates the frequency sweep width per division on the horizontal axis. The sweep width per division on the horizontal axis becomes 1 MHz. Since the frequency on the scale center has been set at 100 MHz in Step 4, the MS710[ ] is now measuring a frequency of 100 MHz ±5 MHz. (See Fig. 3-8.)

| Step | Procedure |
|---|---|

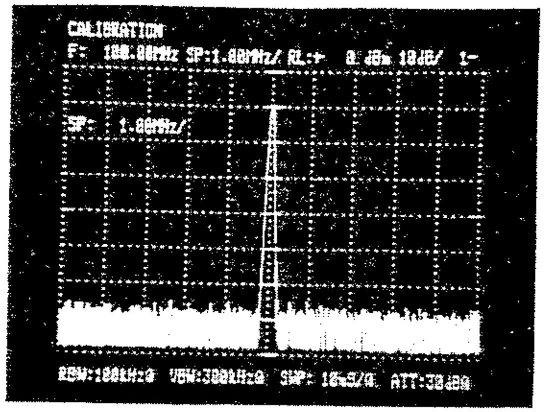



Fig. 3-8 Span Setting to 1 MHz/div

| | |
|---|---|
| 6 | Press [FREQ SPAN/DIV] #5 [1] [0] [0] [kHz].<br>Confirm that the CAL SIGNAL is displayed at the center of the horizontal axis. |

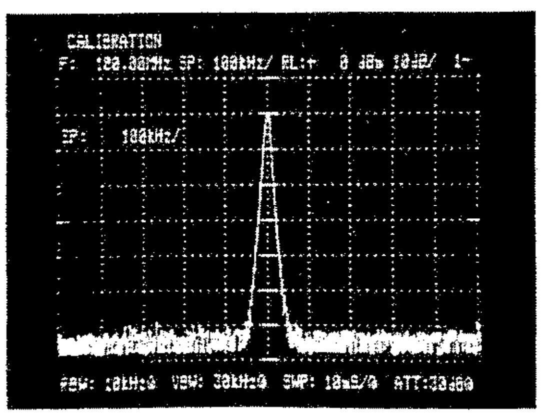



Fig. 3-9 Span Setting to 100 kHz/div

| Step | Procedure |
|---|---|
| 7 | Press [REFERENCE LEVEL] #11 [-] [1] [0] [dBm]<br>(Level calibration begins with this step.)<br>The top horizontal line of graticule on the CRT shows the absolute amplitude reference level. Since the CAL OUTPUT signal level is set precisely at -10 dBm, turn LEVEL CAL #51 so that the peak level matches the top horizontal line under this condition. |
| 8 | Press [LOG] #9.<br>This operation changes the vertical line scale from 10 dB/div to 5 dB/div. If pressed two more times, the scale changes to 1 dB/div after 2 dB/div. Turn LEVEL CAL at 1 dB/div so that the peak of the spectrum accurately matches the top horizontal scale line. (See Fig. 3-10.)<br>Self-calibration is now ended. |

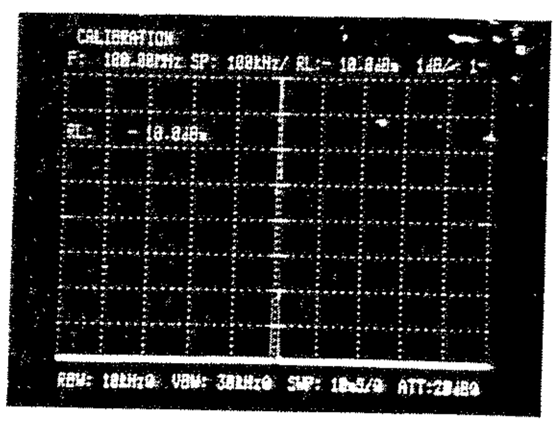



Fig. 3-10 Level Calibration at SCALE 1 dB/div

Calibrations of the level accuracy in the 1.7 to 23 GHz band and the 10 kHz to 30 MHz band are not required because they are automatically calibrated by the calibration procedure for the 100 kHz to 2 GHz band explained above.

Frequency calibration is not required because it is precisely calibrated by the internal PLL circuit.

---

Press [SAVE] #34 [9] after the above operations are completed. Refer to paragraph 3.6.8, Step 4.

## 3.6 Operation Check (Operation Example)

### 3.6.1 Introduction

The MS710[ ] has new functions for performing measurements quickly and efficiently. Actual use of such functions are introduced below.

Basic operations of the Spectrum Analyzer, are setting the required frequency band, center frequency, frequency span (sweep width), reference level, and vertical scale, and observing the spectrum. All these operations are explained in paragraph 3.5. Therefore, actual measurements can be made using the same methods described for self calibration in paragraph 3.5.

(1) FREQUENCY and LEVEL settings

The main parameters for performing measurements with the MS710[ ] Spectrum Analyzer are related to the frequencies that determine the horizontal scale, the level (reference level) that determines the vertical scale, and parameters related to the scale. These function switches are located on the front panel in the FREQUENCY #1 and LEVEL #8 sections. The MS710[ ] is able to perform its basic operations when the data for the functions in these two sections are input. The parameter values are displayed at the top of the CRT.

(2) COUPLED FUNCTION

Four measurement parameters, (resolution bandwidth, video bandwidth, sweep time, and input attenuator) are contained in the COUPLED FUNCTION #24 section. They are automatically set by the MS710[ ] in AUTO mode to ensure the best measurement conditions. It is recommended that these functions be left in AUTO mode unless otherwise specified. A function set to AUTO displays the symbol (@) at the end of the CRT data.

### 3.6.2 Initialization: reset

When [1.7G-23G] #3 of the FREQ BAND is pressed without any input to RF INPUT #30, the CRT displays the data shown in Fig. 3-11. This is the same as the display shown in Fig. 3-5 immediately after the power is turned on; the FREQ BAND [1.7G-23G] #3 can reset all settings for initialization. The following conditions are set automatically as shown on the CRT display in Fig. 3-11:

| | |
|---|---|
| Frequency: | START - STOP sweep of 1.7 GHz to 23 GHz |
| Level: | Reference level 0 dBm, vertical scale 10 dB/div |
| COUPLED FUNCTION: | All AUTO (SWP: ******@) shows a START-STOP frequency sweep mode and indicates that manual selection of sweep time cannot be made. (See paragraph 4.8.3.) |

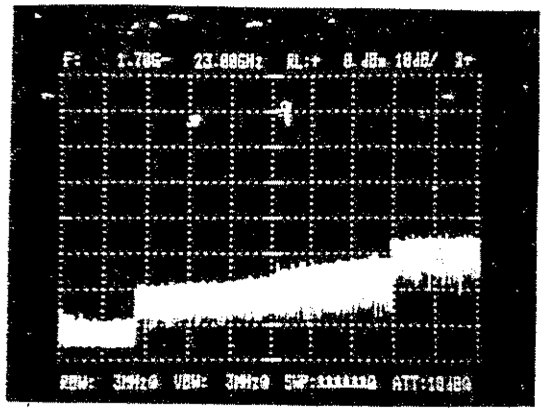


Fig. 3-11  Initial State, 1.7 G - 23 GHz BAND

Key #2 of the [100K-2G] Hz band and Key #55 of the [10K-30M] Hz band of the MS710C also have a reset function but, as shown in Fig. 3-12 (a) and Fig. 3-12 (b), the frequency is as follows:

Frequency:  START-STOP sweep of 0 MHz to 2 GHz ([100K-2G] Hz band)

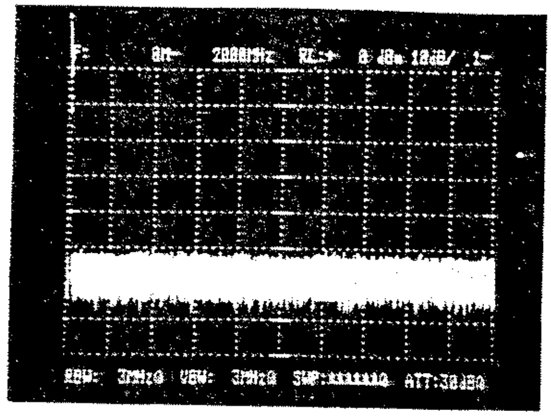
Frequency:  START-STOP sweep of 0 kHz to 30 MHz ([10K-30M] Hz band)

ATT (setting of the input attenuator) is automatically changed from 10 dB to 30 dB by the AUTO COUPLED FUNCTION, to prevent distortion by limiting the input level at the mixer.  The other functions are as follows, for any band:

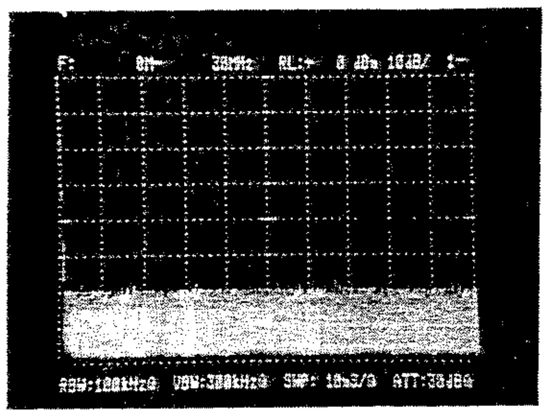
DISPLAY #43:  WRITE NORMAL A and READOUT A, ON, others, OFF

TRIGGER #36:  FREE RUN

If these frequency band select keys are pressed by mistake, to recover the former setting, press [RECALL] #33 and [0], (see 3.6.8 panel setting memory).



(a) 100K - 2GHz BAND



(b) 10K - 30MHz BAND

Fig. 3-12 Initial State

### 3.6.3 Receive signal: peak to center

| Step | Procedure |
|---|---|
| 1 | Press the [1.7G-23G] #3 key. |
| 2 | Connect a 2.5 GHz signal to the RF INPUT on the front panel using an appropriate coaxial cable. The display on the CRT should be as in Fig. 3-13. |

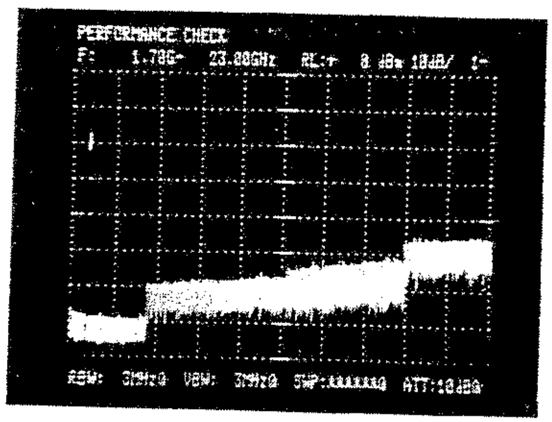



Fig. 3-13 2.5 GHz Signal

To analyze the signal in more detail, it must be received at the center of the display and a smaller span must be used.

There are four methods, for doing this.

Method 1: Specify center frequency as a numeric value.

Since the frequency of the signal in this example is known (2.5 GHz), this method is simple and preferable.

Press [CENTER FREQ] #4 and [2] [.] [5] [GHz].

The sweep mode is changed to CENTER (FREQ = 2.500 GHz) and SPAN (=200 MHz/) settings.

Method 2: Use Signal Search function

Press the [PEAK → CENTER] #12 key.

The sweep mode is changed to CENTER (FREQ= Frequency of the signal) and SPAN (200 MHz/) setting.

Method 2 is a special feature of the MS710[ ] and is convenient for automatically setting the maximum level signal frequency on the CRT display to the center frequency.

Method 3: Expand after confirming the signal frequency with a center frequency marker

When [CENTER FREQ] #4 is pressed, a bright line marker appears at the center vertical scale on the CRT display. This marker indicates the frequency that is to become the next center frequency and is displayed on the CRT as "CTR: 12.350 GHz". When the data knob is turned to the left, the marker moves to the left and the numeric display for the CTR: also changes. When the marker reaches a point where the objective signal is, press [FREQ SPAN/DIV] #5.

An example of the center maker is shown in Fig. 3-14.

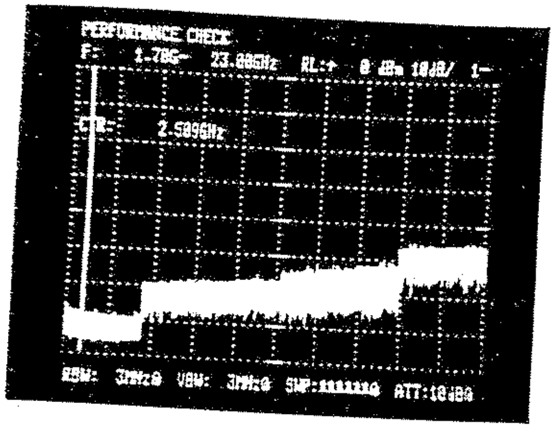



Fig. 3-14 Center Marker

Method 4: Use Marker → Center function.

This method is useful for receiving any signal on the display, especially when the frequency of the signal is not known and its amplitude is not displayed as a maximum value. Follow the procedure outlined below.

| Step | Procedure |
|---|---|
| 1 | Press the [MARKER] #20 key to list the Marker functions. |
| 2 | Press the [CENTER FREQ] #4 key.<br>A bright vertical line will appear as a Marker. |
| 3 | Move the Marker to the signal position using the Data Knob #23.<br>The frequency and the level of the signal will be displayed on the top line of the CRT as shown in Fig. 3-15. |
| 4 | Press the [MARKER] #20 key to list the Marker functions. |

(cont.)

| Step | Procedure |
|---|---|
| 5 | Press the [PEAK → CENTER] #12 key.<br>The sweep mode is changed to CENTER (FREQ=Marker Frequency) and SPAN (=200 MHz/) settings. |
| 6 | Press the [MARKER] #20 key to list the Marker functions. |
| 7 | press the [OFF] #16 key to end the Marker display and return to the normal display. |

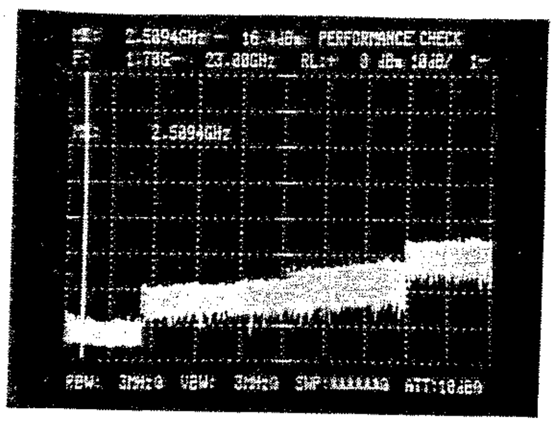



Fig. 3-15  Marker Display

Use of any of the above four methods, will receive the signal at the center of the CRT display. However there will be a small difference between the center of the display and the signal because the span has been changed from the full band sweep to 200 MHz/div.

To correct this center frequency error, use method 2 again. (Press the [PEAK → CENTER] #12 key.)

After this operation, the signal will be correctly received at the center of the CRT display as shown in Fig. 3-16.

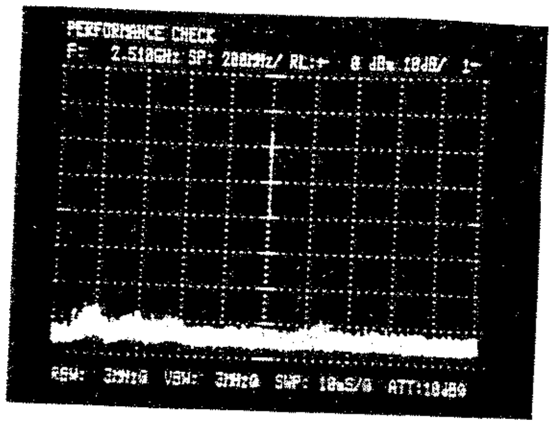



Fig. 3-16 After PEAK → CTR Operation

### 3.6.4 Zooming: span up and down

The span can be changed by two methods.

Method 1: Specify span as a numeric value.

This method is used to directly specify the desired span.

| Step | Procedure |
|---|---|
| 1 | Press the [FREQ SPAN/DIV] #5 key.<br>The present setting value will be displayed on the third line of the CRT display. |
| 2 | Change the set value using number key #21 and unit key #22 or data knob #23. |
| 3 | Press the [PEAK → CTR] #12 key to correct the center frequency. |

Repeating the above steps with different span value input, permits zooming to the signal.

Method 2: Use [ ∨ ]-SPAN-[ ∧ ] keys.

This method is effective for quick zooming.

| Step | Procedure |
|---|---|
| 1 | Press the [ ∨ ] #14 key three times.<br>The span will change from 200 MHz/div, to 100 MHz/div, and 50 MHz/div, sequentially. |
| 2 | Press the [PEAK → CTR] #12 key to correct the center frequency.<br>Repeat the above steps until the desired span is obtained.<br>Figure 3-17 shows a display with a minimum span of 1 kHz/div. |
| 3 | Repeat pressing the [ ∧ ] #14 key until the span is set to 5 MHz/div.<br>The [ ∧ ] key increases the span in a 1, 2, 5, sequence each time it is pressed. |

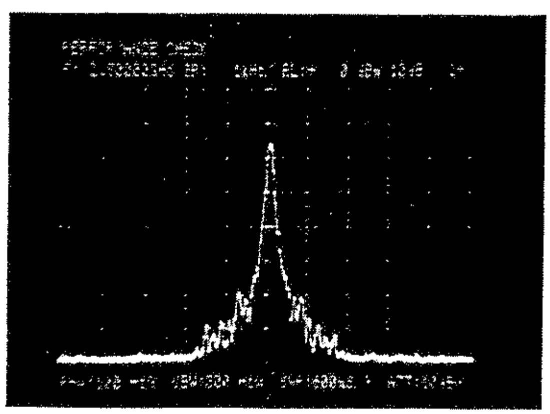


Fig. 3-17 Display with 1 kHz/div

Note:

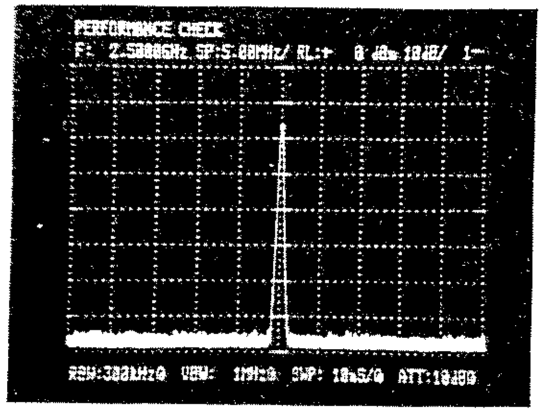
Settings of the coupled functions of resolution bandwidth, video bandwidth, and sweep time are automatically changed to the appropriate value when the span is changed, because they are set to AUTO.

The CRT display at the end of operations in this paragraph is shown in Fig. 3-18 (a).

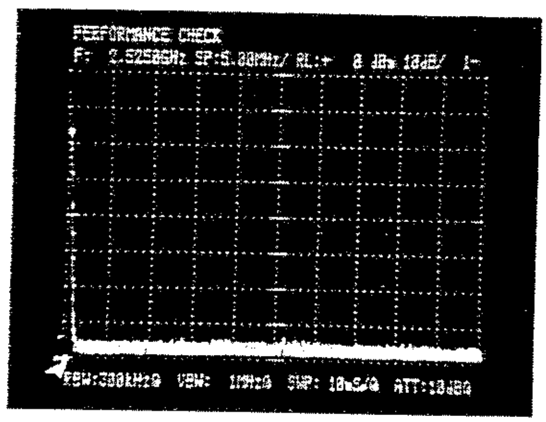
### 3.6.5 Half-screen shift

| Step | Procedure |
|---|---|
| 1 | Press the [ ≫ ] #12 key in SIGNAL SEARCH region.<br>The [ ≫ ] key scrolls the center frequency across by half-a-screen (in this case, 25 MHz since SPAN is 5 MHz/div). Confirm that the center frequency (CTR) is 2.525 GHz in Fig. 3-18 (b). As a result, the signal which was at the center is moved to the left side of the screen. |
| 2 | Press the [ ≪ ] #12 key in SIGNAL SEARCH region.<br>The signal returns to the center and, when pressed again, moves to the right side as shown in Fig. 3-18 (c). |

This function for shifting the center frequency by half-a screen is convenient when immediate confirmation of signals (spurious, etc.) surrounding the signal being observed is required during high-resolution measurements.




(a) Half-Screen SHIFT 1 (Initial)




(b) Half-Screen SHIFT 2 (after [≫] is pressed)

Fig. 3-18 CRT Displays

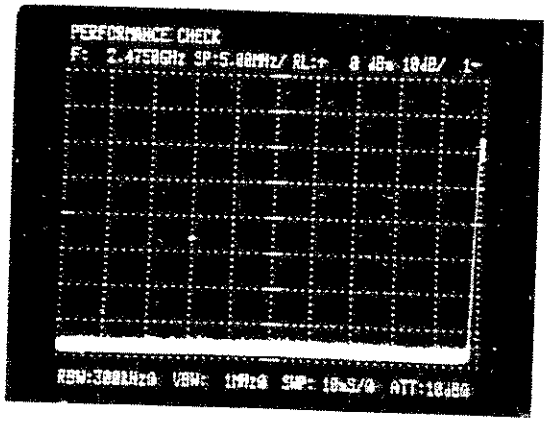



Fig. 3-18 (c) Half Screen SHIFT 3
(after [≪] is pressed)

Use [PEAK → CTR] #12 to return the signal waveform to the center.

### 3.6.6 Reading signal level

The signal level on the CRT display is calculated from the reference level and the vertical scale. The reference level is the level at the top horizontal line of the CRT display.

Change the reference level as follows:

| Step | Procedure |
|---|---|
| 1 | Press the [REFERENCE LEVEL] #11 key.<br>The present setting value will be displayed on the third line of the CRT display. |
| 2 | Change the setting value by using number key #21 and unit key #22 or data knob #23. |

Change the vertical scale as follows:

| Step | Procedure |
| --- | --- |
| 1 | Press the [dB/DIV-LOG] #9 or [LIN] #10 key. |
| 2 | Each time the [dB/DIV-LOG] #9 key is pressed, the vertical scale is changed sequentially in the order of 10 dB/ → 5 dB/ → 2 dB/ → 1 dB/ → and then back to 10 dB/ again.<br>The selected scale is displayed at the right end of the second CRT line. |

The signal level is calculated from the following formula:

Signal Level = RL-DLxVS (dBm)

Reference Level: RL (dBm)

Displacement from the Reference Level: DL (div)

Vertical Scale: VS (dB/div)

In Fig. 3-19, RL = -15 dBm, DL = 1.1 div, VS = 1 dB/div, and signal level = -16.1 dBm.

When the [LIN] #10 key is pressed, the scale is linear to the detected voltage.

The signal level can be read directly with the digital display by using the Marker. Refer to paragraph 4.13 for details of Markers.

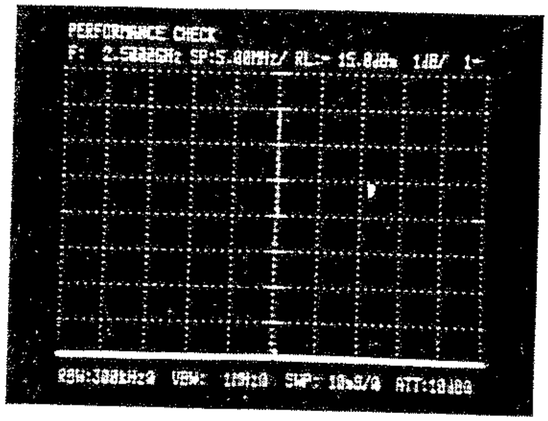



Fig. 3-19  Reading Signal Level

### 3.6.7 Display control

(1) Introduction

In ths MS710[ ], the input signal is usually converted to a digital value according to one of the three sampling modes specified (NORMAL, MAX HOLD, and AVERAGE).

The digitalized value is stored in one of the specified memories, A or B. It is read out and displayed on the CRT display according to the READOUT key settings, independently from the writing operation.

The input signal is not digitalized only when the high-speed sweep of 2 μs/div to 1 ms/div is used under the zero span condition; it is displayed directly on the CRT in analog form.

Keys which specify the control of these memories are located in DISPLAY #43 group.

Use of these controls is explained in this paragraph.

(2) NORMAL Writing and READOUT

| Step | Procedure |
|---|---|
| 1 | Check that LEDs for the WRITE A [NORMAL] and READOUT [A: ON/OFF] keys are on, and the others in the DISPLAY #43 group are off. |
| 2 | Press WRITE B [NORMAL] #49 of the DISPLAY #43 group.<br>The READOUT for both A and B turns ON.<br>The LED in the WRITE A [NORMAL] goes off.<br>The previously written contents are stored in memory A and displayed. The current measurement waveform is written to memory B and displayed at the same time. In this condition, the contents of memories A and B are nearly the same so they overlap each other in the display. |
| 3 | Press the [ ∧ ] #14 key three times.<br>The B waveform will change. |
| 4 | Press the WRITE B [NORMAL] #49 again.<br>The LED for that key will go off.<br>The stored waveform data for both memory A and B are now displayed on the CRT.<br>To turn off the display, follow the next step. |
| 5 | Press the READOUT [A: ON/OFF] or [B: ON/OFF] key to turn off the key LED. |

The waveform data corresponding to the LED-off READOUT key is turned off. If both A and B keys are set to the LED-off state, no waveform data are displayed.

READOUT control is independent from WRITE/STORE keys settings.

(3) MAX HOLD

The MAX HOLD mode records the maximum level of the video signal. The MAX HOLD data memories are cleared when the key is turned ON and held to the maximum value thereafter for subsequent repeated sweeps. Confirm this by following the procedure below.

| Step | Procedure |
|---|---|
| 1 | Press WRITE [A:MAX HOLD] #48.<br>The READOUT A LED lights (LED for READOUT B remains in the same state; it is assumed to be on) and the image shown in Fig. 3-20 is obtained. This displays the stored waveform data written to memory B in NORMAL mode (described in (2)) and the waveform data currently being written to memory A in MAX HOLD mode. |

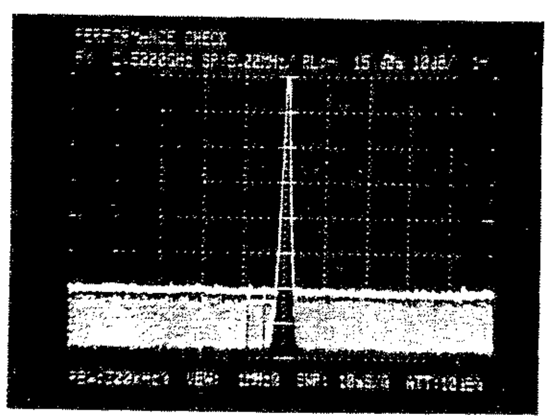


Fig. 3-20 MAX HOLD

(cont.)

| Step | Procedure |
|---|---|
| 2 | Press the [CENTER FREQ] #4 key, and turn the data knob #23.<br>Changes of the A waveform data peak, as shown in Fig. 3-21, can be seen. The MAX HOLD mode is convenient for recording signal frequency variation (drift, etc.). |

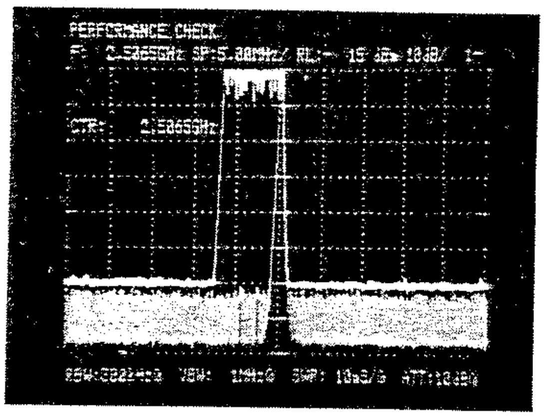



Fig. 3-21 Changing Center Frequency in MAX HOLD MODE

(4) AVERAGE

The AVERAGE mode is effective for separating the signal from noise.

| Step | Procedure |
|---|---|
| 1 | Press WRITE [A:NORMAL] #49. |
| 2 | Press WRITE [B:AVERAGE] #47.<br>By averaging the sampled data, the noise component in waveform data converges to a constant level display, (shown in Fig. 3-22). |

| Step | Procedure (cont.) |
|---|---|
| 2 (cont.) | |

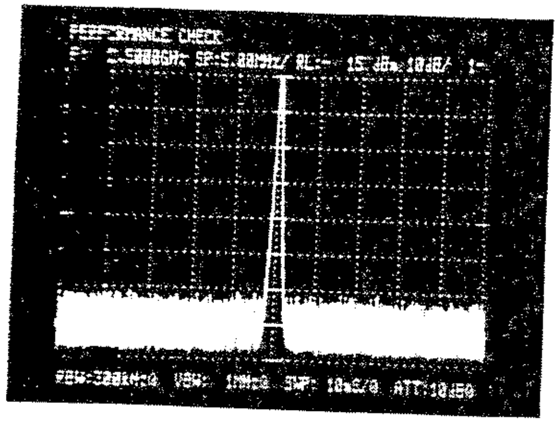


Fig. 3-22 AVERAGE

3 Press the [CENTER FREQ] #4 key and change the center frequency to move the waveform peak position. The data which were at the original peak position decrease gradually while the data at the new position increase gradually, as shown in Fig. 3-23. When signals with spectra which are temporally irregular must be observed, their probability of appearance can be determined in the AVERAGE mode from the height of each spectrum after a period of time.

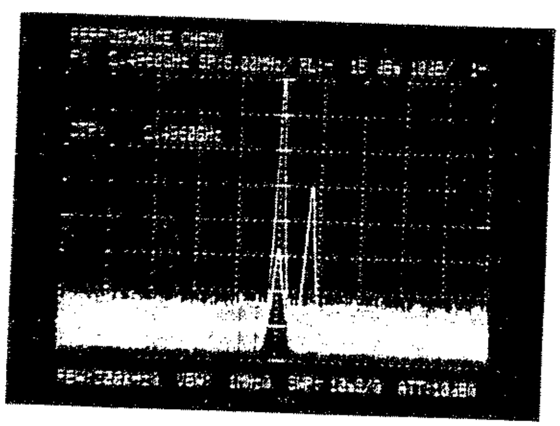


Fig. 3-23 Changing Center Frequency in AVERAGE MODE

(5) A-B Display

As has already been explained, the readout of the contents of the memories A and B can be turned ON or OFF independently regardless of whether they are being written or stored. The contents of both memories can be displayed at the same time. Their difference (A-B) can also be displayed.

| Step | Procedure |
|---|---|
| 1 | Press the READOUT [A-B] #44 key. |
| 2. | Press the READOUT [REF LINE] #45 key several times. |
| | When the difference is displayed, [REF LINE] #45 located below [A-B] #44 indicates where to align the level at which A minus B is zero. |
| | There are three zero positions: top (TP), middle (MD), and bottom (BT) horizontal scale line. |
| | In each time the key is pressed, the zero position is changed sequentially from middle scale (MD) to bottom (BT) and then top scale (TP). Figure 3-24 shows the display of an A-B (REF LINE: MD) mode derived from Fig. 3-23. |

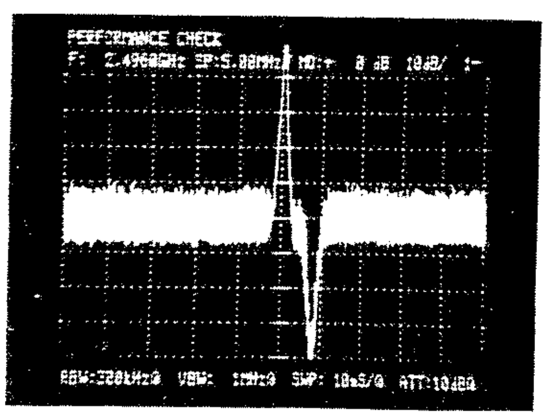



Fig. 3-24 Difference Between A and B

(6) Saving waveform data

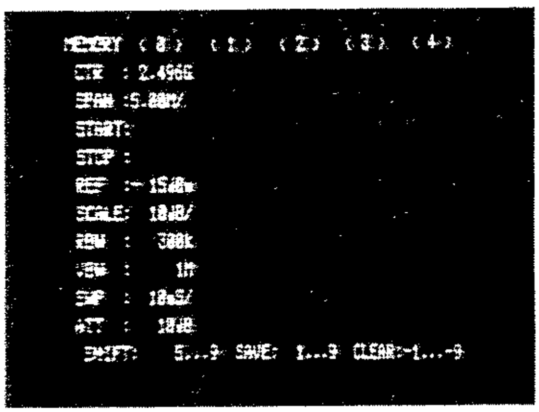
Both memories are backed-up by batteries to retain the contents when the power is turned off. However, the contents of memory A are rewritten by initialization of the MS710[ ] (see paragraph 3.6.2) when the power is turned on again. Store required data in memory B.

To confirm this procedure, turn off power; then turn it on again after a few seconds. Turn READOUT [B:ON/OFF] #46 ON. The waveform data previously written in memory B will be displayed.

However, because the contents of the memory B are easily changed by pressing any of WRITE [B] (NORMAL, MAX-HOLD, AVERAGE), the waveform data which must be reserved should be stored in the display memory as described in paragraph 4.14.

3.6.8 Panel setting memory

The MS710[ ] can store measurement conditions, recall conditions for resetting, and display them in characters on the CRT by a one-touch operation.

| Step | Procedure |
|---|---|
| 1 | Press [SAVE] #34.<br><br>A memory list, shown in Fig. 3-25, is displayed on the CRT.<br><br><br><br>Fig. 3-25 SAVE Memory List<br><br>The final setting conditions before resetting are always stored in memory 0. Therefore, it is possible after power on, to redisplay the measurement conditions existing before power off without any special memory operations. Confirm that the current measurement conditions are displayed. Blanks in the positions of memories one to four indicate that they currently contain no data. |

(cont.)

| Step | Procedure |
|---|---|
| 2 | Press number key [3] to store the current measurement conditions in memory 3.<br><br>The conditions are stored in memory 3 and the CRT display returns to the original normal measuring state. |
| 3 | Press [SAVE] #34 again. A list should be displayed on the CRT, as shown in Fig. 3-26, indicating that the current conditions in memory 0 are stored in memory 3. |

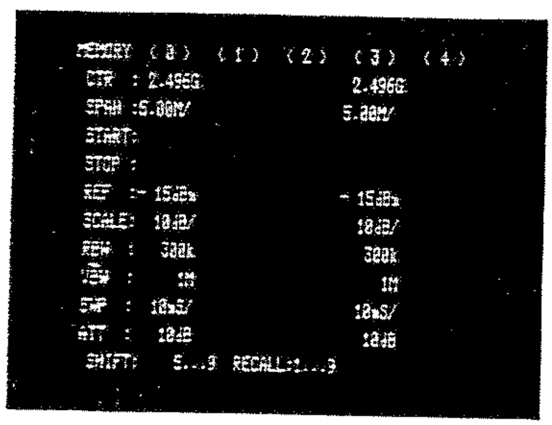



Fig. 3-26 RECALL Memory List

| Step | Procedure |
|---|---|
| 4 | Press the [SHIFT] #19 key. The contents of memories from 5 to 9 are displayed. If the storage operation explained at the end of paragraph 3.5 has been performed, the conditions used in the self-calibration should be stored in memory 9. |
| 5 | Press DATA ENTRY [OFF] #16 to return to normal measurement display from the memory list display. |

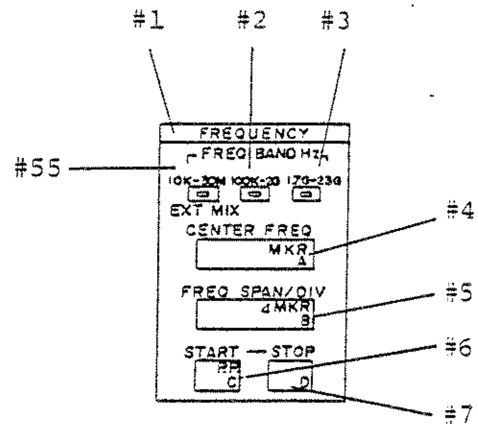
(cont.)

| Step | Procedure |
|---|---|
| 6 | Press [RECALL] #33.<br><br>The memory list is redisplayed (0 to 4 at SHIFT OFF, and 5 to 9 at SHIFT ON). |
| 7 | Press key [1].<br><br>Since there are no data in memory 1, the setting conditions do not change and the error message "NOT SAVED" is displayed. |
| 8 | Turn the power off and then on again after a few seconds. |
| 9 | Press [RECALL] #33 [0].<br><br>The original settings should be recalled. They should be the same as settings displayed when [RECALL] #33 [3] is pressed. |

## SECTION 4

## DETAILS OF PANEL CONTROLS

### 4.1 FREQUENCY




### 4.1.1 FREQ BAND

(1) Function

Selects one of the nine frequency bands; the 1.7 G to 23 GHz band, the 100 kHz to 2 GHz band the 10 kHz to 30 MHz band and the six external mixer bands.

(2) Standard frequency bands

When the [100K-2G] key #2 or [1.7G-23G] key #3 is pressed, as explained in paragraph 3.6.2, full sweep within each band is started and all other panel settings are reset to their initial state.

The frequency band selection for these two standard bands is completed by this switch operation.

The 1.7 GHz to 23 GHz band is divided into four smaller bands according to harmonic mixing order numbers. Since switching is done automatically, operator intervention is not required.

The lowest possible harmonic number is chosen for the smaller conversion loss. The upper limit frequency for each harmonic number is listed below.

For the narrow sweep spans ($\leqq$2 GHz), the harmonic mixing mode is never changed during a sweep. For the wider sweep by the START-STOP settings, the mixing mode may be changed within a single sweep.

The harmonic mixing mode (number and sign*) in use is always displayed at the upper-right corner of the CRT display.

* $f_{RF} = Nf_{LO} \pm f_{IF}$

(N: harmonic number; ±: sign)

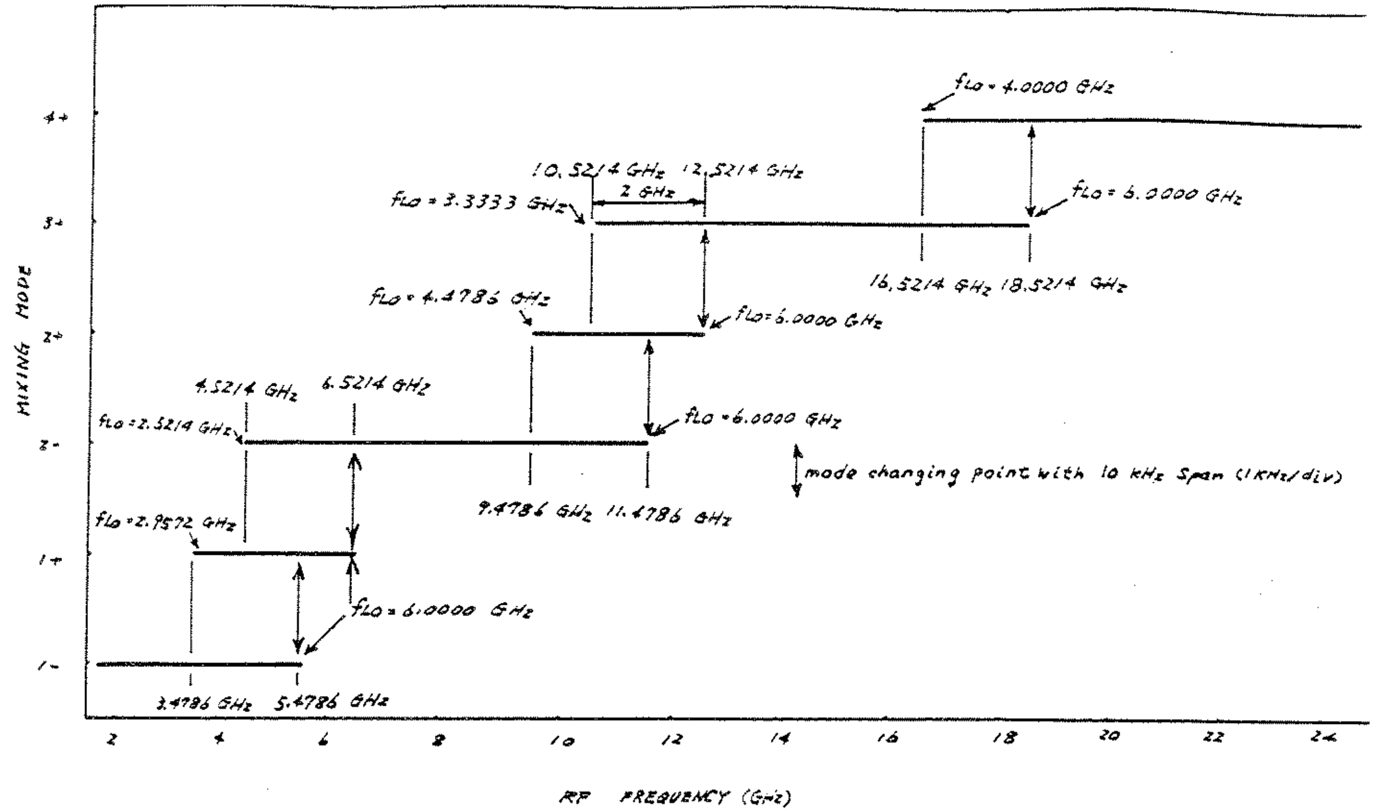



Fig. 4-1 Harmonic Mixing Mode Change for Span ≦2 GHz (≦200 MHz/div)

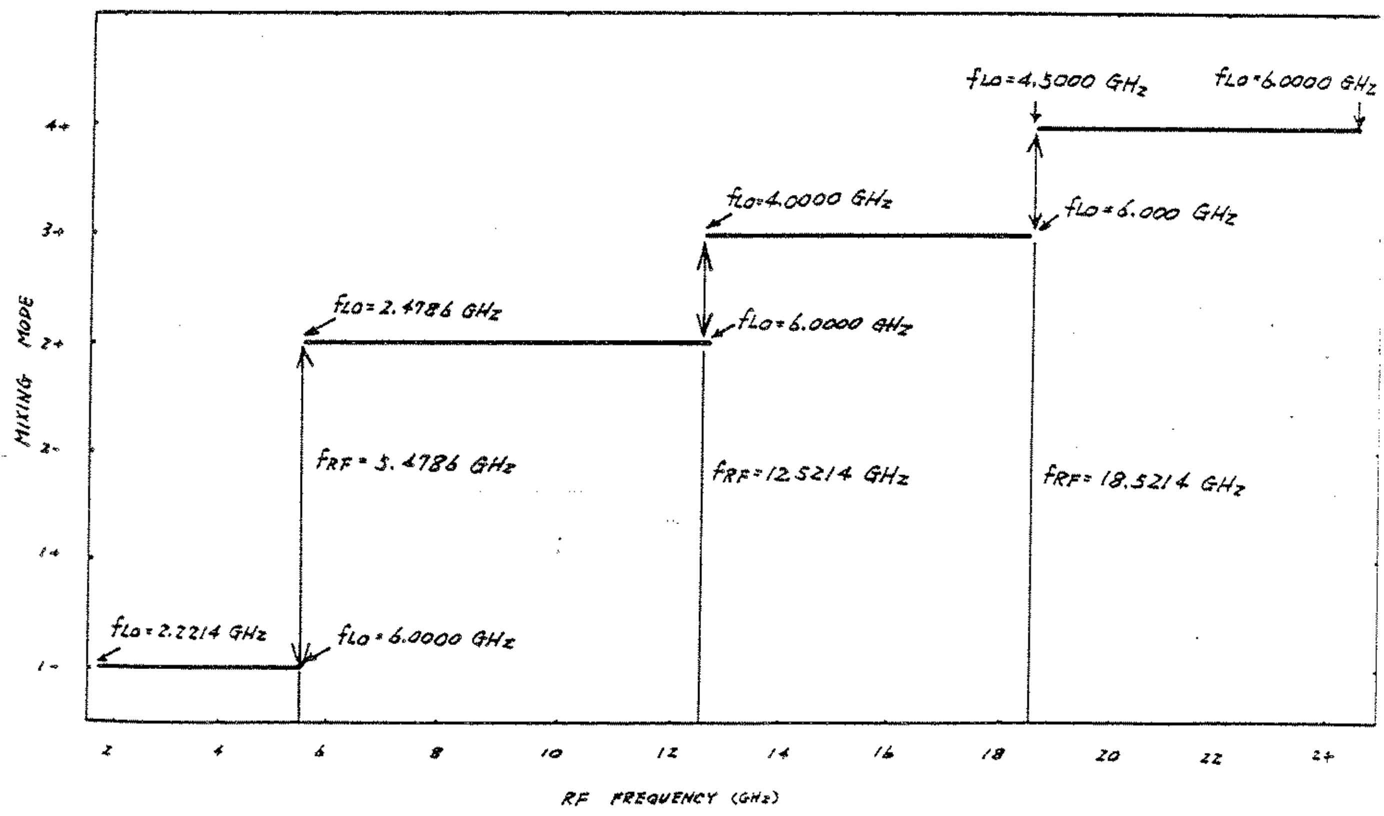



Fig. 4-2 Harmonic Mixing Mode Change for Span >2 GHz (200 MHz/div)

| Harmonic Number | Upper Limit Frequency (GHz) |
|---|---|
| 1 | 6.5214 |
| 2 | 12.5214 |
| 3 | 18.5214 |
| 4 | 24.520 |

(3) 10 K to 30 MHz band and external mixer bands (MS710C/D only)

When the [10K-30M/EXT MIX] key #55 is pressed, the frequency band list as shown in Fig. 4-3 is displayed on the CRT.

Press the number key (1 to 7) which corresponds to the desired frequency band. The initial (full-band sweep) settings for the selected frequency band is obtained.

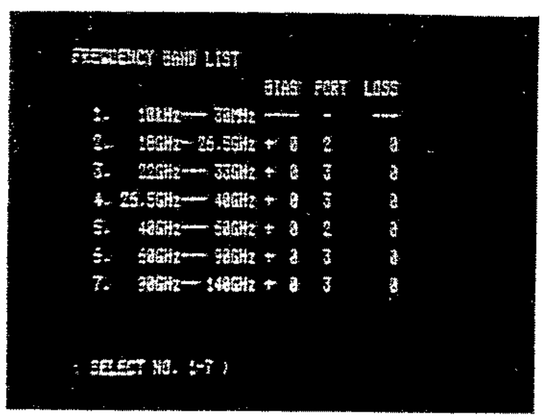



Fig. 4-3 Frequency Band List

### 4.1.2 Center frequency

(1) Function  CENTER FREQ [MKR Δ]

Sets the frequency positioned in the center of the horizontal axis of the CRT.

(2) Setting range

| FREQ BAND [Hz] | Setting Range [Hz] | Maximum Resolution [Hz] Model C | D | E | F |
|---|---|---|---|---|---|
| 1.7G - 23G | 1.700G - 24.520G | 10k | 1M | 10k | 1M |
| 100k - 2G | 0M - 2000M | 10k | 100k | 10k | 100k |
| 10k - 30M | 0k - 30.000M | 1k | - | - | - |
| 18G - 26.5G | 17.990G - 26.510G | 100k | 1M | - | - |
| 22G - 33G | 21.980G - 33.020G | 100k | 1M | - | - |
| 26.5G - 40G | 26.490G - 40.010G | 100k | 1M | - | - |
| 40G - 60G | 40.000G - 60.000G | 1M | 1M | - | - |
| 60G - 90G | 59.960G - 90.040G | 1M | 1M | - | - |
| 90G - 140G | 89.910G - 140.090G | 1M | 1M | - | - |

(Performance at frequencies out of the specified frequency bands is not guaranteed.)

(3) Data input

When [CENTER FREQ] #4 is pressed, data input for center frequency is possible. The current setting value for center frequency is displayed at the live function display area on the CRT. There are two ways to set data; Use number and unit keys or use the data knob.

When data are input with the number keys, they are immediately set to that frequency.

When data are changed using the data knob #23, the amount of change per step in frequency is 10% of the FREQUENCY SPAN/DIV data. Therefore, the frequency can always be changed by the data knob at a fixed rate for the screen regardless of the sweep width.

If the previous setting was the START/STOP sweep with the sweep width ≦2 GHz, it is changed to the CENTER/SPAN mode with the same sweep width. If the previous sweep width in the START/STOP mode exceeded 2 GHz, the span is limited to 200 MHz/div, or a total of 2 GHz after setting the center frequency.

When the sweep frequency range exceeds 2 GHz and [CENTER FREQ] #4 is pressed during START/STOP sweep, a bright-line marker is displayed at the center of the CRT. By turning the data knob #23, the center frequency can be determined while confirming its position. After the marker is moved to the desired frequency, the span is changed to a sweep width of 200 MHz/div centered on the frequency coinciding with the marker by pressing [SPAN] #14 or the [⩔] key.

When the span is zero (zero span), the frequency means the fixed tuning frequency and it can be changed by one tenth of the resolution band width (RBW).

The Data Input process is summarized below. Start by pressing the [CENTER FREQ] #4 key, then;

- o When the frequency sweep width exceeds 2 GHz
  - o Marker is moved by data knob #23 —— o Press [SPAN] #24 or [∀]
  - o Data input by number key #21
- o When the frequency sweep width is less than 2 GHz —— o Input by data knob #23 or number key #21

### 4.1.3 FREQ/SPAN DIV

#5 [FREQ SPAN/DIV ΔMKR 8]

(1) Function

Sets the sweep frequency range per division on the horizontal axis.

(2) Setting range

| | | [Minimum setting digit] |
|---|---|---|
| 200 MHz/div | ----- 21 MHz/div | 1 MHz |
| 20.0 MHz/div | ----- 2.1 MHz/div | 100 kHz |
| 2.00 MHz/div | ----- 0.21 MHz/div | 10 kHz |
| 200 kHz/div | ----- 1 kHz/div | 1 kHz |
| 0 Hz | | |

The minimum setting digit for external mixer bands is multiplied by the harmonic number.

(3) Data input

There are three ways to change the span data, as follows:

- Number keys #21 + Unit keys #22
- Data knob #23
- SPAN key #14, [⋁] [⋀]

The [⋀] and [⋁] keys can change the span data in steps without having to set the SPAN function. However, these two keys can operate only in the center-span setting mode. They do not operate when the sweep range is set to the START-STOP setting mode.

When the sweep frequency range exceeds 2 GHz, the span is changed to 200 MHz/div by pressing [FREQ SPAN] #5. The value of the center frequency is the center of the sweep range when [FREQ SPAN] #5 is pressed.

When the span is 0 Hz, the horizontal axis is a time axis and the instrument functions as a time domain analyzer.

### 4.1.4 START - STOP


#6 #7

(1) Function

Sets the start frequency of the frequency sweep with [START] #6 and the stop frequency with [STOP] #7.

(2) Setting range

Same as the center frequency setting range. The minimum setting resolution is related to the sweep width and is shown as follows.

| Sweep width (STOP - START) | Minimum setting resolution |
|---|---|
| ≧21 GHz | 1 GHz |
| 20 GHz to 2.1 GHz | 10 MHz* or 100 MHz |
| 2.00 GHz to 0.21 GHz | 10 MHz |
| 200 MHz to 21 MHz | 1 MHz |
| 20.0 MHz to 2.1 MHz | 100 kHz (MS710C/E), 1 MHz (MS710D/F) |
| ≦2.00 MHz | 10 kHz (MS710C/E), 1 MHz (MS710D/F) |

* 1.7 to 23 GHz band

(3) Data input

Similar to the center frequency, the START/STOP frequency can be input by using Number key #21 + Unit key #22 or Data knob #23.

When digit data smaller than the minimum setting resolution are input, they are truncated for START data and raised for STOP data.

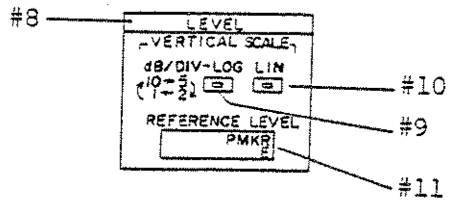
(4) START frequency > STOP frequency

During setting operations, the start frequency often becomes greater than the stop frequency. When this occurs, the MS710[ ] does not display the waveform data until START becomes smaller than STOP.

(5) CENTER-SPAN mode to START-STOP mode change

When [START] #6 or [STOP] #7 is pressed in CENTER-SPAN setting mode, the sweep width at that time is converted to START or STOP frequencies. In such cases, the MS710[ ] automatically changes the sweep width to that which can be expressed in START or STOP frequencies with allowed resolutions.

## 4.2 LEVEL




### 4.2.1 Vertical scale

(1) Function

Selects the CRT vertical scale.

(2) Determining the scale

LOG #9 selects 10 dB/div, 5 dB/div, 2 dB/div, and 1 dB/div sequentially.

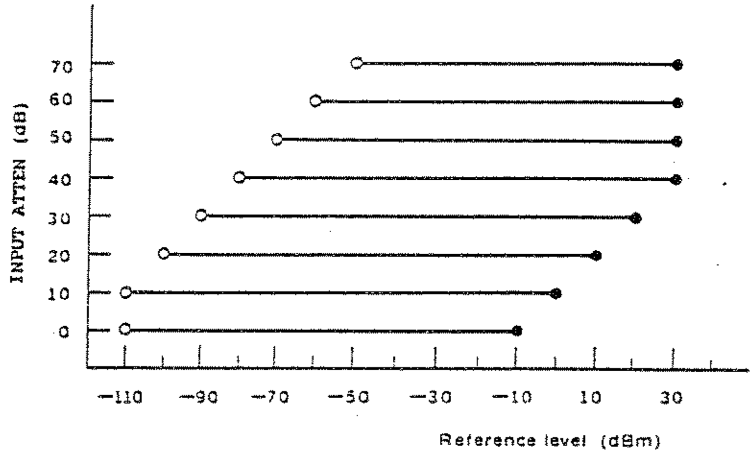
When LIN #10 is pressed, the scale is LINEAR.

### 4.2.2 Reference level

(1) Function

Sets the top horizontal line of the scale on the CRT as the reference level.

(2) Setting range




The setting range of the REFERENCE LEVEL is limited depending on the value of INPUT ATT #26. When INPUT ATT #26 is operating in the AUTO mode, the full range of the REFERENCE LEVEL input (-109 to +30 dBm) is accepted by changing the INPUT ATT #26 value. When not in the AUTO mode, only the value of the REFERENCE LEVEL within the upper or lower limits allowed for the ATT setting at that time is accepted.

In the external mixer bands, the INPUT ATT #26 is not used or fixed to 0 dB, the available REFERENCE LEVEL is from -10 to -105 dBm.

(3) Resolution

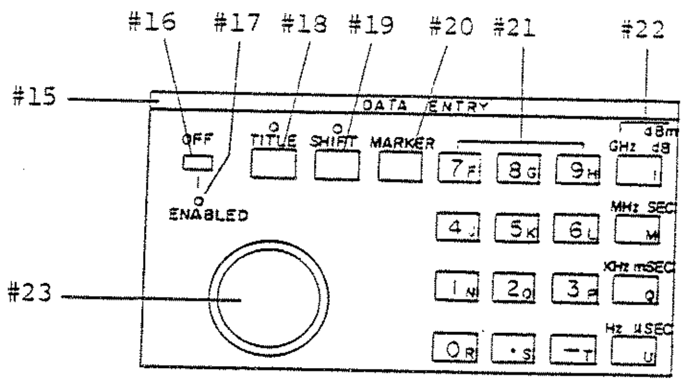
Setting resolution changes depending on the vertical scale.

| Scale | Resolution |
|---|---|
| 10 dB/div, 5 dB/div, LIN | 1 dB |
| 2 dB/div, 1 dB/div | 0.1 dB |

(4) A-B Display

When "A-B" is in active, the "RL:" part of the parameter display line indicates either MD, TP, or BT. This represents whether the level, where the difference is zero, is displayed at the middle, the top, or bottom horizontal scale line. The zero level when [A-B] #44 is pressed is assumed to be 0 dB. After that, when the REFERENCE LEVEL is changed, the difference from the initial value is displayed in dB.

## 4.3 DATA ENTRY




### 4.3.1 Number key

Number keys #21 inputs numeric values when function data can be set (ENABLED #17 LED is on.). Up to seven digits can be input; extra digits are ignored. Data input is terminated when the unit key #22 is pressed. The unit key #22 is ignored when the ENABLED #17 LED is not on.

### 4.3.2 Unit key

Several units are written on a single unit key #22, but the MS710[ ] selects the appropriate one for the current function.

#### 4.3.3 Data knob

Data knob #23 changes the function data without having to press the unit key #22 when in the ENABLED mode. When turned clockwise, the numeric values of the data increase. When turned counterclockwise, the numeric values decrease. The amount of change per step differs with the selected function.

#### 4.3.4 ENABLED/OFF

When the Frequency, Level, or function keys (RES BW, VIDEO BW, SWEEP TIME, and INPUT ATTEN) are pressed, the LED of ENABLED #17 lights and data can be input. Pressing the [OFF] key #16 ends data input; any further input of data is ignored. Also, the function and the parameter on the data input line disappears from the CRT and the LED goes off.

#### 4.3.5 TITLE

TITLE #18 enables writing of alphanumeric characters on the top field of the CRT. In the TITLE #18 function, the alphabetic keys can be input when SHIFT #19 is on, and the number keys can be input when SHIFT #19 is off. These inputs are displayed on the CRT in the order input. When the [TITLE] key is pressed, the LED of [SHIFT] #19 turns ON automatically, allowing input of alphabetic characters.

#### 4.3.6 SHIFT

SHIFT #19 enables selection of alphabetic or numeric input when the TITLE key #18 is on. In memory list status, pages are changed for memories 0 to 4 and 5 to 9. In any other status, when SHIFT #19 is pressed the SHIFT FUNCTION LIST is displayed as follows on the CRT.

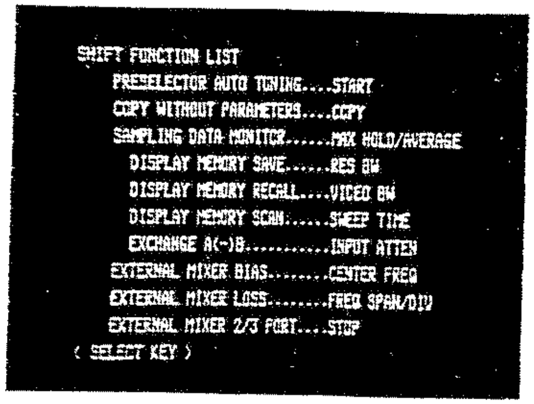
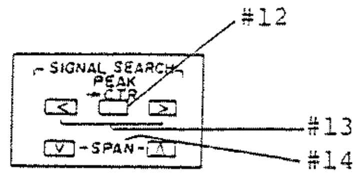



Fig. 4-4 SHIFT FUNCTION List

If COPY #35 is pressed, copies of only the signal trace and graticule are made when SHIFT #19 is ON; the entire CRT display is copied when it is OFF. The SHIFT key is also used for the Preselector Auto-tuning (See paragraph 4.10), sampling data monitoring in MAX HOLD and AVERAGE mode (See paragraph 4.5 (7)), display memory operations (See paragraph 4.14), and various settings for external mixers (See paragraph 4.15).

## 4.4 SIGNAL SEARCH




(1) Function

SIGNAL SEARCH enables quick and easy searching for signals. It provides functions for setting the frequency of the maximum level signal on the CRT to the center frequency (PEAK → CTR), for shifting the CRT screen by half-a-screen to the left or right ([≪], [≫]), and for changing the frequency span directly up or down ([⩓], [⩔]). Signals can be found efficiently by using these five keys.

(2) PEAK → CTR

PEAK → CTR #12 sets the highest level frequency on the CRT to the center frequency. If more than one frequency has the same level, the lowest one is chosen for the center frequency. If the sweep frequency range exceeds 2 GHz when PEAK → CTR is operated in the START-STOP setting mode, the span is changed to 200 MHz/div after the operation and the sweep mode is also changed to the center-span setting mode. When [PEAK → CTR] #12 is pressed with the sweep in a wide range, the peak of the signal may not come to the exact center because calculation accuracy drops due to the wide sweep width. The peak can be returned to the center by pressing the key two or three times.

When this key is pressed after the MARKER key, it works as a MARKER → CTR key. See paragraph 4.13.5 for this function.

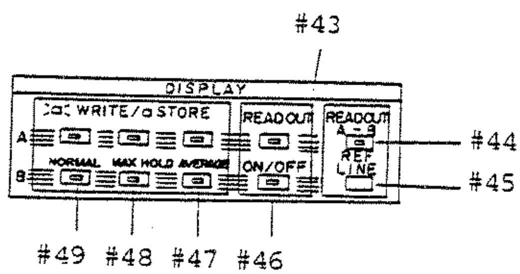
(3) [≪], [≫]

These keys shift the center frequency by the frequency amount corresponding to the half-a-screen value to the left or right. This function is convenient for observing adjacent frequency ranges quickly. They do not operate when sweep is specified with the start-stop setting mode.

(4) [⋀], [⋁]

These keys increase or decrease the frequency span data without having to specify the SPAN #14 function. Data are increased or decreased in a 1-2-5-10 sequence. They do not operate when the sweep is specified with the start-stop setting.

## 4.5 DISPLAY




(1) Function

Selects the waveform data processing method.

(2) [NORMAL] #49

Writes the sampled data in the waveform memory.

(3) [MAX HOLD] #48

Writes the sampled data in the waveform memory only when data greater than the previous value are obtained in each sweep.

(4) [AVERAGE] #47

Writes the averaged value of the data obtained with each sweep into the waveform memory.

(5) READOUT

Determines the waveform stored in memory display method.

| | |
|---|---|
| [ON/OFF] #46: | Determines whether or not to display the waveform. |
| [A-B] #44: | Subtracts the contents of the waveform memory B from those in memory A and displays the result. |
| [REF LINE] #45: | (Reference line)<br>Determines where to set the reference line (line where the difference A-B is zero).<br>The TP (top), MD (middle), or BT (bottom) horizontal scale line can be selected. |

(6) Combination of keys

The MS710[ ] has two waveform memories A and B for recording waveform data. These two memories are equivalent and can be used as required. Only one of the six keys (NORMAL #49, MAX HOLD #48, and AVERAGE #47) of the WRITE/STORE group can be ON (WRITE mode) at any time. Therefore, when one of them is pressed to ON, the other keys are automatically turned OFF. At the same time, the READOUT corresponding to the pressed key also goes ON.

When a key already ON is pressed, that key turns OFF, and the data previously written is stored.

The READOUT group can operate one of the three from among "A," "B," of [ON/OFF] #46 and [A-B] #44, at a time. This means that the image of A-B and A or B cannot be displayed on the CRT at the same time. When A-B is turned ON, the A and B memories are automatically turned OFF.

When the READOUT keys of A, B, and A-B are all OFF, only the scale and the measuring parameters are displayed on the CRT. The waveform data are not displayed.

(7) Sampling data monitors

When MAX HOLD or AVERAGE is used, the sampled real-time data can be monitored.

To monitor the data, press the [MAX HOLD] #48 or [AVERAGE] #47 key when the shift LED is lit. The sampling data are displayed by using the waveform memory other than the one which is storing the MAX HOLD or AVERAGE data.

This operation is ended when MAX HOLD or AVERAGE write is turned off or the status of the READOUT [ON/OFF] is changed. It is also ended when [A-B] #44 is pressed.

After the monitoring operation is ended, the original waveform data stored before the monitoring are returned to the waveform memory.

(8) Automatic setting of DISPLAY

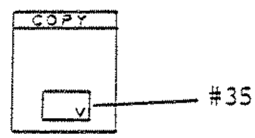
All DISPLAY keys are automatically controlled by the MS710[ ] in the following cases:

o When [COPY] #35 is pressed --- The WRITE/STORE group turns OFF.

o When in fast sweep ----------- All DISPLAY keys turn OFF.
(Sweep time: 2 µs/div to 1 ms/div)

After the above operation is completed, the DISPLAY is restored to its original state.

## 4.6 COPY




(1) Function

Copy #35 outputs the display data on the CRT to the specified plotter or printer.

(2) Connecting a plotter or printer

A specified plotter or printer can be connected to the MS710[ ] directly by using one of the two interfaces below:

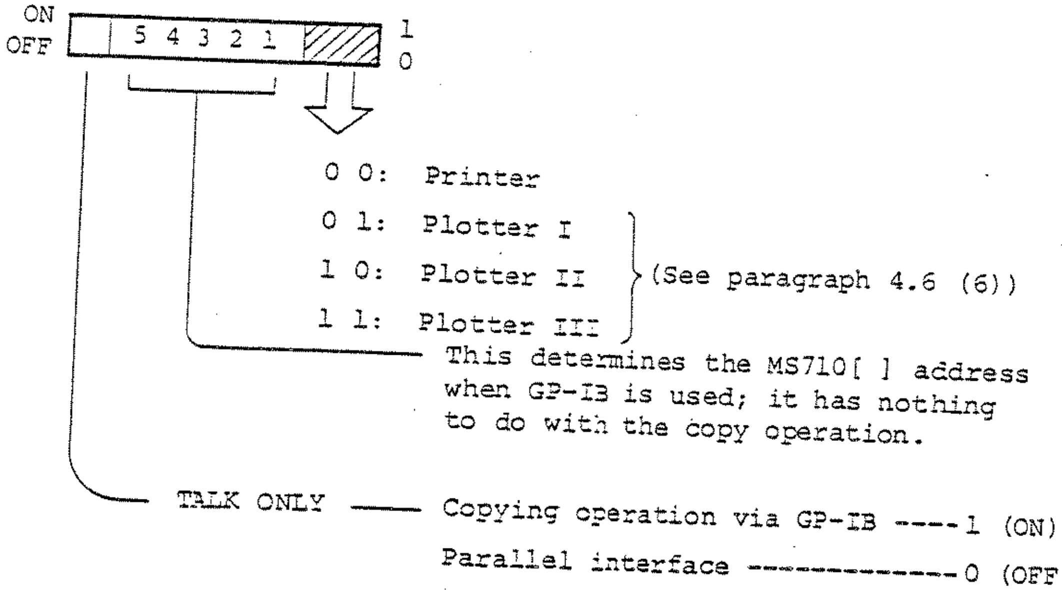
- o GP-IB
- o Parallel interface

Simply use the special cables to connect the plotter or printer. Controllers are not needed.

However, the following switches must be pre-set:

o MS710[ ]

Set the GP-IB address switch on the rear panel as follows:




o Plotter/printer (Operation by GP-IB)

Set the GP-IB address switch of the plotter to LISTEN ONLY.

When the GP-IB is used, the MS710[ ] must be set to TALK ONLY and the plotter and printer set to LISTEN ONLY.

If the connections are correct, copying is immediately started when the [COPY] key #35 is pressed. If the connection or switch settings on the rear panel of the MS710[ ] are incorrect, an audible alarm will sound. To stop copying, press the [COPY] key #35 again. If the plotter or printer has buffers, copying continues until the buffer is empty.

(3) Copying in fast sweep

Waveform data is not copied in fast sweep. (Sweep time: 2 µs/div to 1 ms/div)

(4) Data output in copies

In the copy operation, the displayed image data are output. However, if [SHIFT] #19 has been pressed before [COPY] #35 is pressed, only the displayed waveform data and graticule are output. When the memory list is displayed, the list displayed at that time is output.

(5) Notes on using the plotter

When outputting at the plotter, different pens are used for each of the following:

- o Scale and measuring parameter
- o Waveform data A
- o Waveform data B
- o Waveform subtraction result A-B

The necessary pens should be ready for use. The memory list is output in only one color.

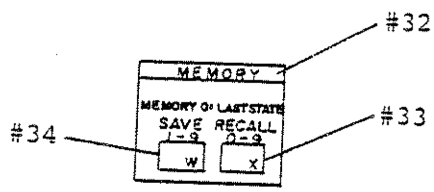
(6) Printer and plotter

The MS710[ ] can output directly to the following printers and plotters:

| | | |
|---|---|---|
| Printer: | Anritsu | DPR7713A |
| | Epson | RP-80, others |
| Plotter I: | Anritsu | DPL7716A |
| | Graphtec | FP5301 |
| | Matsushita | VP-6803A/6804A |

| | | |
|---|---|---|
| Plotter II: | Graphtec | DA6000 MIPLOT Jr. |
| | Graphtec | MP1000 MIPLOT II |
| | Graphtec | MP2000 MIPLOT III |
| | Graphtec | DA8400 Servoplot |
| | Matsushita | VP-6801B |
| | Matsushita | VP-6802A |
| | Hitachi | 671-10 |
| | Hitachi | 671-20 |
| Plotter III: | Hewlett Packard | 9872C |
| | Hewlett Packard | 7470A |
| | Hewlett Packard | 7475A |
| | or other HP-GL compatible plotters | |

## 4.7 MEMORY




(1) Function

Up to 10 sets of panel settings can be saved and/or recalled.

(2) Specification of memory numbers

A memory list is displayed when [SAVE] #34 or [RECALL] #33 is pressed. The memory list indicates the contents of the memories storing up to 10 setting conditions. When 1 to 9 or -1 to -9 is pressed at SAVE, or 0 to 9 at RECALL, saving/clearing at SAVE or recalling at RECALL is done for the memory corresponding to each number. When the values are input, the screen returns to the spectrum display at the saved or recalled condition.

(3) Changing pages of the memory list

Only 5 memory lists can be displayed on the CRT at one time. To display the remaining five, press the [SHIFT] key #19. Each group of five pages can be displayed alternately by pressing the [SHIFT] key #19.

(4) Copying the memory list

When [COPY] #35 is pressed while the memory list is displayed, a copy of the list will be output at the printer or plotter.

(5) Memory 0

Each time one sweep ends, the measuring parameters at that time are automatically written in memory 0 without any key operation. Therefore, even if the power is turned off during use, the condition prior to power off can be recalled by pressing [RECALL] #33 [0]. The recalled contents are not written in memory 0 until another key operation is made.

(6) SAVE

The panel setting conditions at that time are written to memory. They are written to the memory number corresponding to the input value. Since the write operation is terminated when the number key is pressed, be sure that the number to be written is correct.

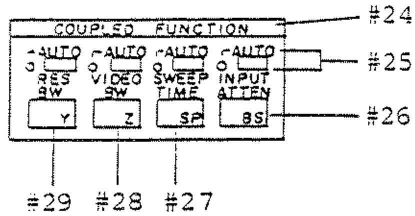
When the minus (-) key is pressed before the numeric value is input, it clears (CLEAR operation) the contents of the memory indicated by the memory number.

(7) RECALL

This recalls the panel setting conditions stored in the memories and resets the conditions. The operation is completed when a number key is pressed.

When a number which is not saved is specified by RECALL #33, the setting conditions remain unchanged and the error message "NOT SAVED" is displayed.

## 4.8 COUPLED FUNCTION




### 4.8.1 Resolution bandwidth (RES BW)

(1) Function

Selects the IF filter bandwidth (6 dB width).

(2) Setting range

100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz

(3) RES BW and SWEEP TIME

When reading two adjacent signals, the frequency resolution can be increased by reducing the RES BW. As the band is reduced, the sweep time must be increased in inverse proportion to the square of the RES BW. When the RES BW value is reduced by 50%, the SWEEP TIME must be increased four fold.

(4) AUTO

Sets the most appropriate value corresponding to the current frequency span. Normally, the RES BW should be set to AUTO.

(5) AUTO automatic cancellation

If the SPAN becomes zero during AUTO, it automatically changes to the manual operation mode. Therefore, set the RES BW to the value required for measurement.

(6) Setting values during AUTO

| FREQ SPAN/DIV | RES BW |
|---|---|
| 1 kHz | 100 Hz |
| 2 kHz to 5 kHz | 300 Hz |
| 6 kHz to 20 kHz | 1 kHz |
| 21 kHz to 50 kHz | 3 kHz |
| 51 kHz to 200 kHz | 10 kHz |
| 0.21 MHz to 1 MHz | 30 kHz |
| 1.01 MHz to 5 MHz | 100 kHz |
| 5.1 MHz to 20 MHz | 300 kHz |
| 21 MHz to 100 MHz | 1 MHz |
| ≥ 101 MHz | 3 MHz |

4.8.2 Video bandwidth (VIDEO BW)

(1) Function

Selects the video filter bandwidth. When the VIDEO BW is reduced, the noise is averaged.

(2) Setting range

1 Hz, 3 Hz, 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, and 3 MHz

(3) Video BW and SWEEP TIME

When the input signal level is close to the average noise, signal measurement is made easier by averaging the noise with a reduced VIDEO BW. However, as the bandwidth is reduced, the sweep time must be increased in inverse proportion to the VIDEO BW. If the VIDEO BW is reduced by 50%, the SWEEP TIME must be doubled.

(4) AUTO

Sets the most appropriate value corresponding to the current SWEEP TIME and RES BW. Normally, the VIDEO BW should be set to AUTO.

(5) Setting values during AUTO

| RES BW | VIDEO BW |
|---|---|
| 100 Hz | 300 Hz |
| 300 Hz | 1 kHz |
| 1 kHz | 3 kHz |
| 3 kHz | 10 kHz |
| 10 kHz | 30 kHz |
| 30 kHz | 100 kHz |
| 100 kHz | 300 kHz |
| 300 kHz | 1 MHz |
| 1 MHz | 3 MHz |

### 4.8.3 SWEEP TIME

(1) Function

Selects the sweep time per division.

(2) Setting range

When the span is not zero:

2 ms/div to 10 s/div
(Can be set in 1 ms steps).

For zero span:

2 µs/div to 10 s/div
(2 µs to 1 ms: Can be set in 1 µs steps
$\geqq$ 2 ms: Can be set in 1 ms step).

(3) Setting restrictions

The sweep time can be set only in the center-span setting mode and in the start-stop setting mode with span $\leqq$2 GHz; it cannot be set in start-stop setting mode with span >2 GHz. When the FREQUENCY is set at the start-stop mode with span >2 GHz, the sweep time is always AUTO and ****** @ is displayed. The value of the sweep time at AUTO is determined according to the values of SPAN #14, RES BW #29, and VIDEO BW #28.

(4) Digital memory restrictions

When the sweep time is in the fast sweep mode from 2 µs/div to 1 ms/div, the digital memory for display cannot be used. Therefore, for such a sweep time, the trace is displayed directly on the CRT bypassing the memory. The entire status of the DISPLAY key #43 is then turned off automatically.

(5) AUTO and UNCAL

When the sweep time is in AUTO, the fastest sweep time that does not produce level errors is performed. The sweep time, however, is not set to less than 10 ms/div.

When the entire trace of the signal is needed immediately, a faster sweep than the value set by AUTO can be performed by manual operation. However, if UNCAL is displayed on the CRT, it indicates that the frequency and level include errors.

To obtain a correct trace free from errors, use a range where UNCAL is not displayed.

### 4.8.4 Input attenuation (INPUT ATT)

(1) Function

Sets the attenuation of the input attenuator.

(2) Setting range

0, 10, 20, 30, 40, 50, 60, and 70 (dB)

(3) Restrictions on settings

The setting range of the input attenuation value is limited by the value of the REFERENCE LEVEL #11. When data that cannot be set are input, the MS710[ ] sounds an audible alarm and changes the input data automatically to the upper or lower limit value allowed for the setting. (See paragraph 4.2.2(2))

(4) Internal circuitry protection

Settings between 10 dB and 70 dB can be made in 10 dB steps, using data knob #23. However, 0 dB cannot be set using data knob #23. This is to protect the internal circuitry from damage by mis-setting to 0 dB. Enter [0] [dB] by number and unit keys for a 0 dB setting.

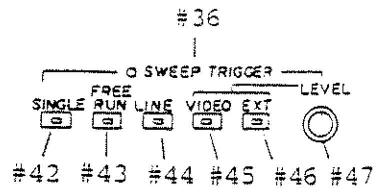
(5) AUTO

When the INPUT ATT is set to AUTO, the input attenuation value is set so that the maximum input level at the mixer due to the reference level is the highest level at which distortion does not occur. (See paragraph 4.2.2.(2))

(6) External Mixer Bands

When an external mixer is used, the input attenuator is set to 0 dB automatically and cannot be changed manually.

## 4.9 SWEEP TRIGGER




(1) Function

Determines any one of five sweep trigger modes.

(2) [SINGLE] #42

A single sweep is made each time the key is pressed. However, this does not function in the fast sweep made (sweep time: 2 μs/div to 1 ms/div.)

FREE RUN occurs when this key is pressed during the fast sweep made.

(3) [FREE RUN] #41

A sweep is repeated each time it ends by an internal timer setting.

(4) [LINE] #40

A sweep is made synchronously with the ac line frequency.

(5) [VIDEO] #39

When a signal exceeding a preset level is received, the MS710[ ] is triggered and starts sweeping. The preset level can be adjusted using the LEVEL knob #37 on the right side of the SWEEP TRIGGER keys.

(6) [EXT] #38

The sweep is triggered by an external signal. The threshold voltage of the external trigger signal can be varied using the LEVEL knob #37 (+0.5 to +5 V).

## 4.10 PRESELECTOR PEAKING

### 4.10.1 Manual peaking


The PRESELECTOR PEAK knob #50 is used to fine adjust the tracking preselector tuned frequency in the 1.7 GHz to 23 GHz band. Normally, if the mark on the knob is in the range of the ▬ mark, good tracking characteristics are obtained. When it is necessary to read the signal level more accurately, make a finer adjustment so that the signal level displayed on the CRT is as high as possible.

### 4.10.2 Automatic peaking

The preselector is automatically tuned for the maximum response.

This tuning operation is only effective in the 1.7 G to 23 GHz band and ≦50 MHz/div span.

Operation is started by pressing the [START] #6 key when the shift LED is lit and SHIFT FUNCTION LIST is displayed by pressing the [SHIFT] #19 key.

When no marker is displayed, tuning is performed for the highest level signal on the screen. When the marker is displayed, tuning is performed at the marker frequency.

When operation starts, input from keys is not accepted until the end of the tuning operation.

When the tuning operation starts, the MS710[ ] automatically makes the necessary settings for SPAN 0 Hz and RBW 3 MHz. However, at the end of the operation, the settings are returned to their original state.

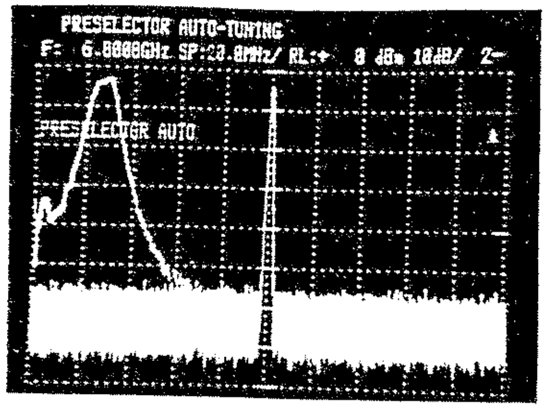



Fig. 4-5 Preselector Auto Tuning

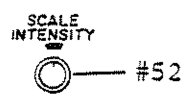
Note:

During operation, the preselector tuning process is displayed on the CRT.

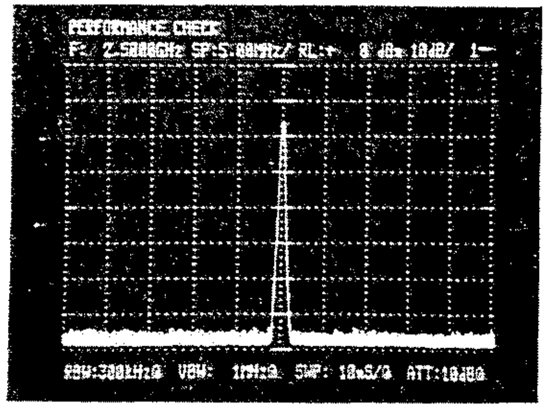
At this time, if the reference level is set to a low value, depending on the conditions, the peak data may exceed the upper limit of the screen.

If the upper limit is exceeded, the level conditions must be reset so that the peak value is on the screen.

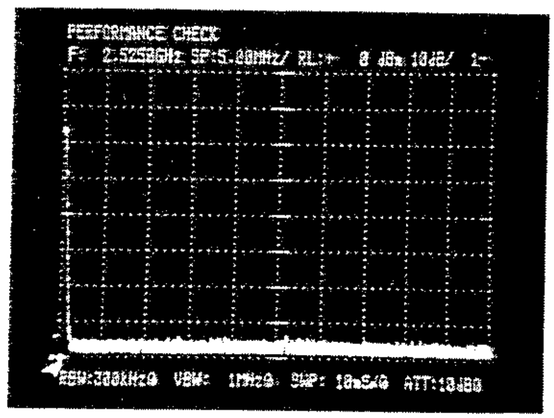
## 4.11 SCALE INTENSITY




The SCALE INTENSITY knob #52 changes the intensity of the scale and measurement parameters displayed on the CRT. Normally, the intensity is adjusted for the optimum reading in the range of mark. If reading the data is difficult because the spectrum is on the scale line, lower the scale intensity to make reading easier.




(a) Half-Screen SHIFT 1 (Initial)




(b) Half-Screen SHIFT 2 (after [≫] is pressed)

Fig. 3-18 CRT Displays

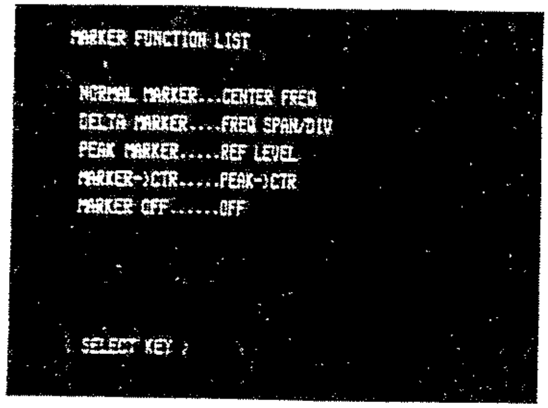



Fig. 4-6 MARKER FUNCTION list

(1) Marker waveform data display

The data for only one waveform, A or B can be displayed by the marker.

The waveform data which will be displayed by the marker conform to the following rules:

- When both waveforms A and B are displayed, the marker corresponding to the waveform whose readout is performed last will be displayed.
- When only one waveform is being displayed, the marker for that waveform will be displayed.
- When neither waveform is displayed, no marker will be displayed.

(2) Title line restrictions

During marker display, the number of displayed characters for the title is limited. This is because the frequency and level display of the marker use the same line as the title display. When no marker is displayed, a title of up to 48 characters can be input. However, when the marker is displayed, title input is limited to 20 characters.

(3) Marker restrictions

When no waveform is displayed on the screen, or the MS710[ ] is set to zero frequency span, marker operation is not performed. If all the readouts are turned off or the frequency span is set to zero during marker operation, the marker disappears from the screen.

### 4.13.2 Normal marker [MARKER] + [CENTER FREQ]

(1) Function

A vertical line appears on the CRT as the marker. The frequency and level at the point at which the marker and waveform intersect are displayed numerically at the top of the CRT.

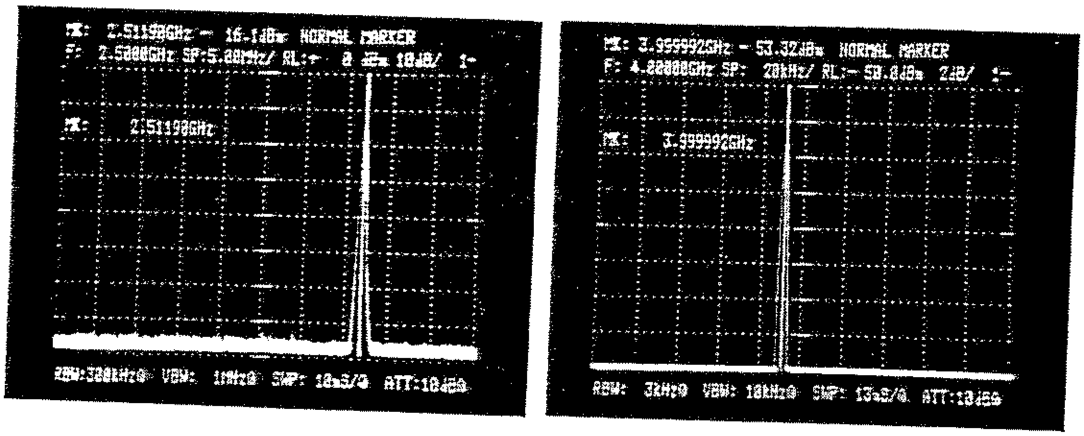
(2) Start of normal marker operation

Operation is started by pressing the [CENTER FREQ] #4 key when the MARKER FUNCTION LIST is displayed by pressing the [MARKER] #20 key. However, this operation is not actuated when no waveform is displayed or when the frequency span is set to zero.

(3) Setting range

Same as center frequency setting range.

The marker frequency can be set with the numeric keys or the data knob.
The minimum setting resolution for the MARKER is 1/500 of the total sweep width.




(a) (b)

Fig. 4-7 Normal Marker

(4) Marker position

When the Normal Marker function is actuated for the first time after the power is turned on, the marker appears at the center of the screen. When the [MARKER] #20 + [CENTER FREQ] #4 keys are pressed thereafter, the marker appears at the position where it was before the marker is turned off.

(5) Marker frequency and level resolution

The marker frequency display resolution is 1/50 of the span/div (≧1 kHz). The level display resolution is 1/100 of one division of the vertical scale.

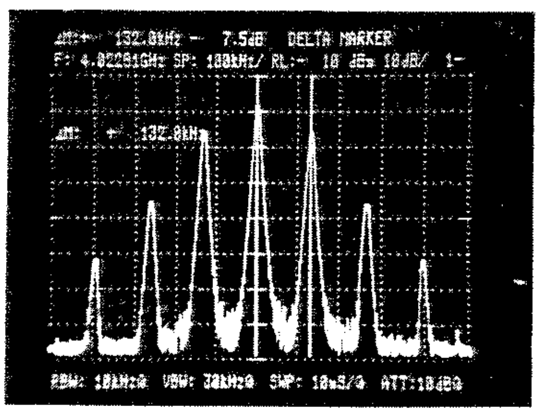
### 4.13.3 Delta marker [MARKER] + [FREQ SPAN/DIV]

(1) Function

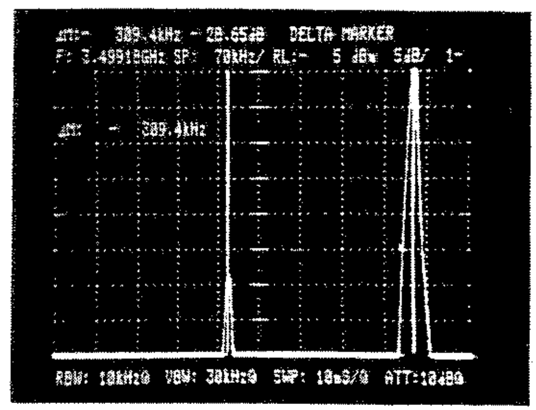
Two vertical lines appear on the CRT as the markers. The frequency and level differences between the two points at which these markers intersect the waveform are displayed numerically on the top line of the CRT.

(2) Start of delta marker operation

When the [FREQ SPAN/DIV] #5 key is pressed when the MARKER FUNCTION LIST is displayed by pressing the [MARKER] #20 key, operation starts. However, this operation is not actuated when no waveform is displayed or when the frequency span is set to zero.




(a)




(b)

Fig. 4-8 Delta Marker

(3) Reference marker and active marker

If delta marker operation is actuated, two markers are displayed. Each of these markers is set as described in (5). The marker which becomes the reference for reading is called the reference marker. The reference marker cannot be moved during delta marker operation. (The reference marker is moved only by normal marker operation.) However, the active marker can be moved during delta marker operation. The deviation from the reference marker is read by using this active marker.

(4) Setting range

Same as the centr frequency setting range.

The frequency deviation from the reference marker in each range can be set with the digits which differ with the span as follows.

| Frequency Span/Div | Setting Minimum | Input data Minimum |
|---|---|---|
| > 2.1 GHz/div | 40 MHz | 10 MHz |
| 2.00 to 0.21 GHz/div | 4 MHz | 1 MHz |
| 200 to 21 MHz/div | 400 kHz | 100 kHz |
| 20.0 to 2.1 MHz/div | 40 kHz | 10 kHz |
| 2.00 to 0.21 MHz/div | 4 kHz | 1 kHz |
| 200 to 21 kHz/div | 400 Hz | 100 Hz |
| 20 to 1 kHz/div | 20 Hz | 10 Hz |

(5) Marker position

When the [MARKER] #20 + [FREQ SPAN/DIV] #5 keys are pressed, the reference marker and active marker are displayed in two ways.

a) Before the keys are pressed, if the normal marker was displayed, the reference marker and active marker are superimposed over each other and displayed. Therefore, it appears as if only one line is displayed on the screen.

b) Before the keys are pressed, if other than the normal marker was displayed, the two markers appear where the delta markers were before they were turned off.

(6) Marker frequency and level resolution

The display resolution of the frequency difference between the two markers is the same as the minimum setting of the setting range. The level display resolution is 1/100 of one division of the vertical scale.

### 4.13.4 Peak marker [MARKER] + [REFERENCE LEVEL]

(1) Function

The marker is placed at the peak level on the screen. At the same time, frequency and level at that position are displayed. This always displays the peak value, even when the signal is moved.

(2) Start of peak marker operation

Operation is started by pressing the [REFERENCE LEVEL] #11 key when the MARKER FUNCTION LIST is displayed by pressing the [MARKER] #20 key. However, this operation is not actuated when no waveform is displayed or when the frequency span is set to zero.

(3) Peak marker operation

Marker data cannot be input for the peak marker. This is because the peak value is always displayed. This operation is continued until another marker is used or the marker is turned off.

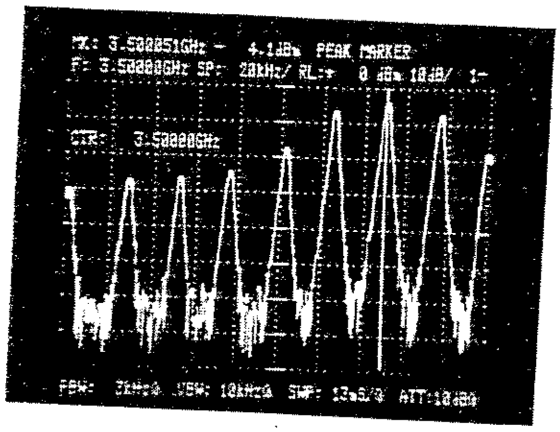



Fig. 4-9 Peak Marker

4.13.5 Marker → center [MARKER] + [PEAK → CTR]

(1) Function

The reference marker frequency is set as the center frequency.

(2) Start of "marker → center" operation

Operation is started by pressing the [PEAK → CTR] #12 keys when the MARKER FUNCTION LIST is displayed by pressing the [MARKER] #20 key. However, this operation is not actuated when no marker is displayed.

One "marker → center" operation is completed each time the keys are pressed.

#### 4.13.6 Marker off [MARKER] + [OFF]

(1) Function

The marker display is turned off.

(2) Marker off operation

To stop the use of the marker function, press the [OFF] #16 key when the MARKER FUNCTION LIST is displayed by pressing the [MARKER] #20 key. This erases the marker display from the CRT and ends the marker function. Operating the [OFF] #16 key without operating the [MARKER] #20 key is the same as usual [OFF]. That is, marker data input setting is inhibited, but marker operation continues.

### 4.14 Display Memory

#### 4.14.1 General

A maximum of nine display data items (trace, title, measurement conditions) can be saved in the battery backed-up display memory and saved data can be recalled on the CRT by an operation combining the [SHIFT] key and a key in the COUPLED FUNCTION key group.

The saved display data can be listed and the contents can be checked in scanning mode.

#### 4.14.2 Display data save: [SHIFT] + [RES BW] + [n]

(1) Function

Stores the data displayed on the CRT in the display memory.

(2) Operation

When the [SHIFT] key #19 is pressed and then the [RES BW] key #29 is pressed, the display memory list is displayed as shown in Fig. 4-10.

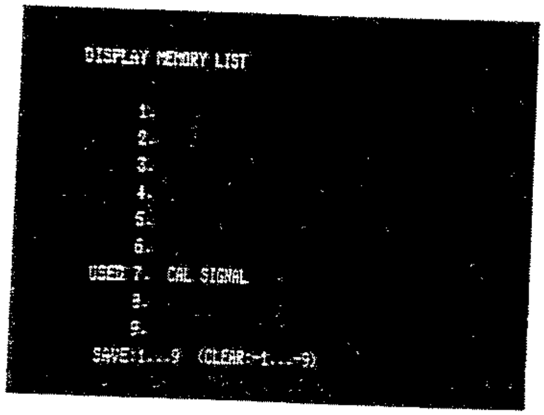



Fig. 4-10 Display Memory List

USED indication before a memory number indicates that data has been previously stored in that memory, and the title attached to the data is displayed (see No. 7 shown in Fig. 4-10).

One of the memory numbers 1 to 9 in which data is to be stored in can be input using the ten key pad. If a memory number that has already been used is input, the previous contents are deleted and the current data (trace data in which READOUT LED is ON) displayed on the CRT is stored.

When READOUT A and B are both ON or OFF, save is not executed. The message "A OR B?" is displayed to enquire whether TRACE A or B is to be saved; restart the initial operation by setting only the required one to READOUT ON.

Notes:

1. When "- and memory number" is input to a number which has a USED indication, the memory contents are deleted and become blank.
2. When only the measurement conditions are stored without requiring the trace data and title, use the memory function (see paragraph 4.7 Memory).

4.14.3 Display data recall: [SHIFT] + [VIDEO BW] + [n]

(1) Function

Reads the display data stored in the display memory and displays it on the CRT.

(2) Operation

When the [SHIFT] key #19 is pressed and then the [VIDEO BW] key #28 is pressed, the display memory list is displayed as shown in Fig. 4-11. This example shows that data is stored in the memories 1 and 7.

Then, if one of the memory numbers 1 to 9 to be read is input using the ten key pad, the display data saved in the specified memory is written in trace memory B and TRACE B is automatically set to READOUT ON. Thus the saved data is displayed on the CRT. All DISPLAY #43 functions are set to OFF except READOUT B.

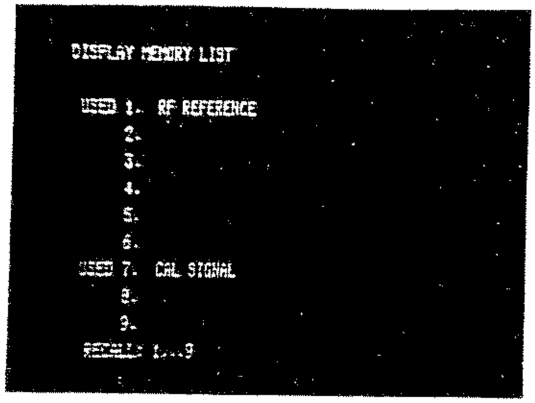



Fig. 4-11 Display Memory List

Note:

When this recall is executed, the measurement conditions are modified into the read display memory contents and the conditions set before recall are not saved.

If the original measurement conditions must be reproduced, store them by using the memory function or use the display memory scan (see paragraph 4.14.4).

4.14.4 Display memory scan: [SHIFT] + [SWEEP TIME] + [n]

(1) Function

Displays the data saved in the display memory on the CRT. Unlike the recall described in paragraph 4.14.3, read data is only displayed temporarily on the CRT. When the scan operation is completed, the function returns to the original operation status.

This function is useful to check the memory contents and create hard copies.

(2) Operation

When the [SHIFT] key #19 is pressed and then the [SWEEP TIME] key #27 is pressed, the trace data becomes blank as shown in Fig. 4-12 and "MEMORY SCAN:" is displayed. Then, if one of the numerics 1 to 9 is keyed in, the data stored in the corresponding memory is displayed as shown in Fig. 4-13. If the data is not saved in the specified memory, "NOT SAVED" is indicated.

Press the [OFF] key #16 to complete the memory scan. As a result, the function returns to the status before the scan operation started.

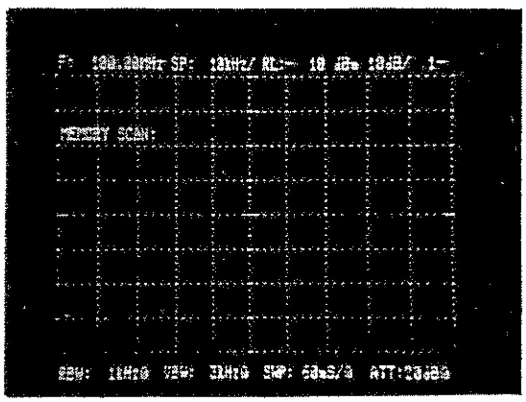


Fig. 4-12 Memory Scan

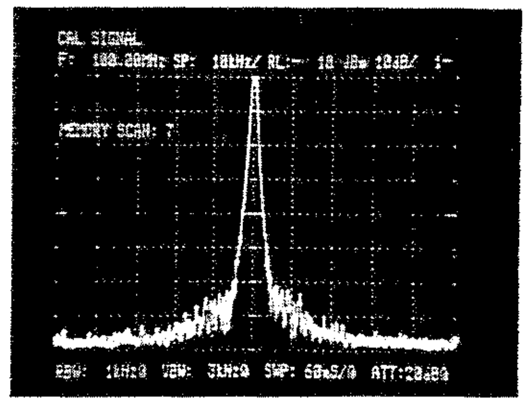



Fig. 4-13 Memory Scan

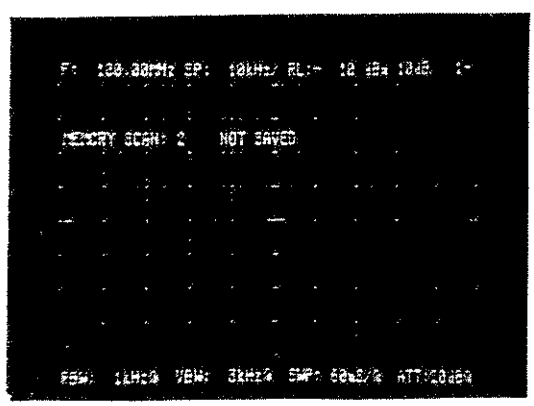



Fig. 4-14 Memory Scan

### 4.14.5 Display data exchange: [SHIFT] + [INPUT ATTEN]

(1) Function

Exchanges trace memory contents A and B. This function is used to transfer the contents recalled in trace memory B to trace memory A and invert the sign of the difference between A and B.

(2) Operation

When the [SHIFT] key #19 and then the [INPUT ATTEN] key #26 is pressed, exchange is executed. If the WRITE LED of either trace memory A or B is ON, the data transferred to the ON side is immediately overwritten by new contents.

## 4.15 Using an External Mixer (MS710C/D)

The MS710C/D can be used with a 2- or 3-port external mixer.

Read and follow the precautions so that the diodes used in the external mixer are not damaged by static electricity, excessive input power, etc.

Precautions:

1. Use 3-pole power cords for the MS710C/D and a device under test. If a 2-pole power cord or a 2-pole adapter with a 3-pole plug is used, connect the ground terminal on the rear of the MS710C/D and the ground terminal of the device.

2. First, connect a cable to the MS710C/D, then connect the cable to the external mixer.

   If a charged cable is used and connected to the external mixer directly, diodes may be damaged because the charged electricity will be discharged through them.

3. The maximum input power of the external mixer depends on a external mixer used. (Tektronix 490 Series: +20 dBm max.)

4. The maximum input power of the local signal depends on the external mixer used. The MS710C/D local-oscillator maximum output level is +13 dBm (+7 dBm min).

   If the MS710C/D local-oscillator output level exceeds the maximum local input power of the external mixer, the external mixer may be damaged, so read the mixer specifications carefully. (The maximum local input level of the Tektronix 490 Series is +15 dBm, so they can be connected directly to the MS710C/D.)

5. A ±2.3 V, ±17 mA limiter is located in the mixer bias circuit of the MS710C/D.

Bias is applied to the both Local Output and IF Input ports at the same time (see Fig. 4-15).

When using an external mixer without bias, adjust the mixer bias to 0 before connecting the Mixer to the MS710C/D (refer to the measurement procedure).

The Tektronix 490 Series bias is 3 V, 20 mA max, so the diodes cannot be damaged by the bias circuit.

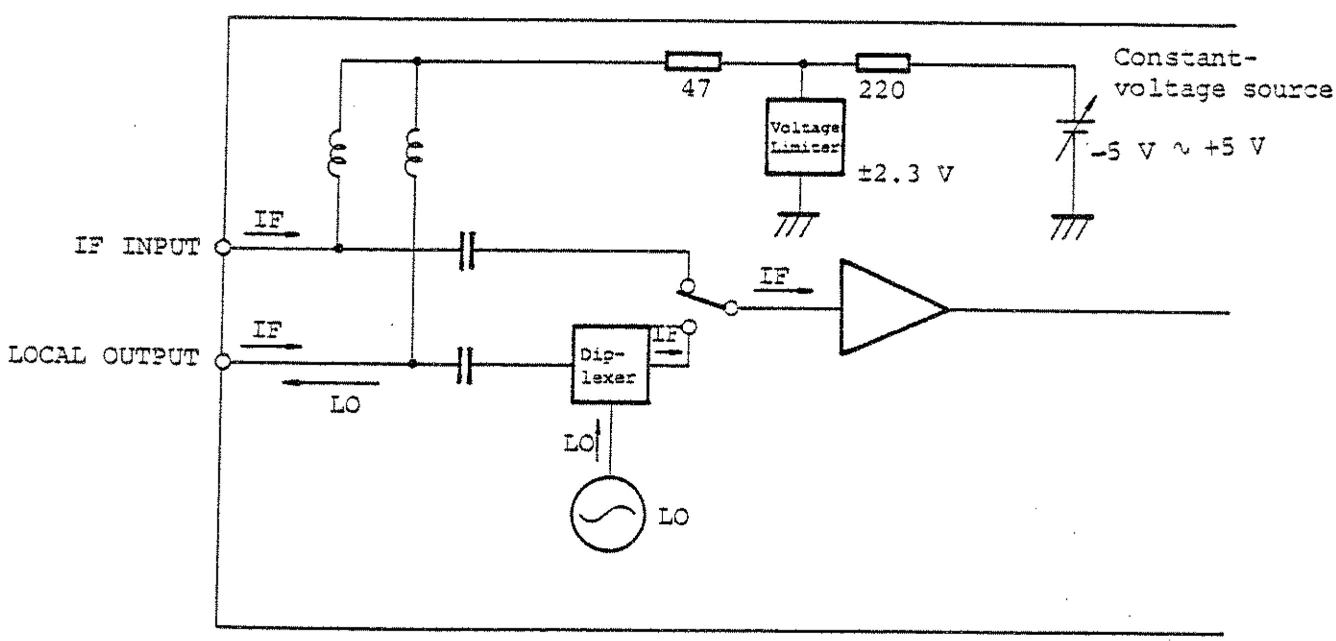



Fig. 4-15 MS710C/D External Mixer DC Bias Supply Circuit

4.15.1 Measurement procedure

Measurement Procedure:

There are two functional settings before connecting the external mixer: Frequency band selection and BIAS, PORT, and LOSS settings.

(1) Frequency band selection

When the [FREQ BAND] select key is pressed, a list like that shown in Fig. 4-16 is displayed on the CRT. When a numeral key is pressed in this state, a frequency band is selected for the band corresponding to the numeric key. For example, when the numeric [4] is pressed, the frequency band is set to 26.5 to 40 GHz full span.

If the [FREQ BAND] select key is pressed again, the same list as Fig. 4-16 is displayed; however an asterisk (*) appears at the left side of the number 4 (in this example).

This asterisk indicates that the MS710C/D frequency band has been previously set to the 26.5 to 40 GHz band.

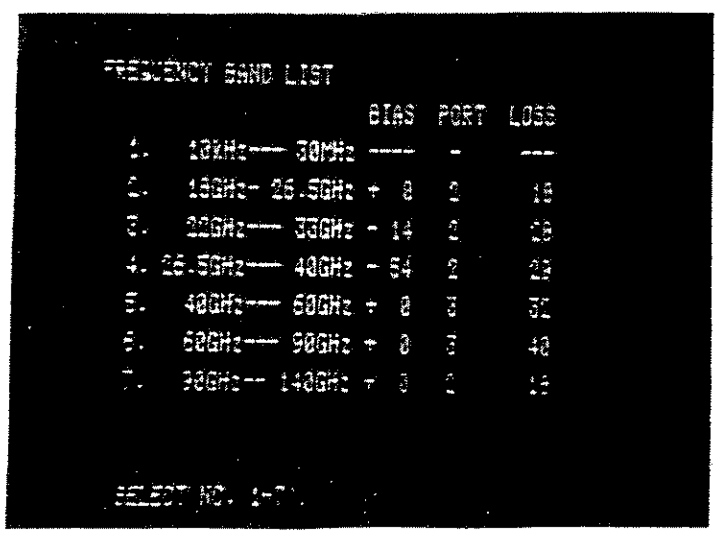



Fig. 4-16 Frequency Band List

(2) BIAS, PORT, and LOSS settings

Figure 4-16 also lists the BIAS, PORT, and LOSS set values.

The meanings of these words are described below.

(a) BIAS

BIAS is the dc bias applied to the external mixer.

When using a mixer without bias, set BIAS to 0.

Otherwise, set BIAS to a value so that the mixer conversion loss is minimized; first, set BIAS to 0, then adjust to get the maximum spectrum level after the spectrum appears on the CRT.

A set BIAS value is a value represented by percentage as ±5 V (the voltage of the constant-voltage source shown in Fig. 4-15) is ±100%.

(b) PORT

Port sets the number of external mixer ports. Set the PORT number to 3 if a mixer with an independent IF Output Port is used. For a mixer with a common Local Input Port and IF Output Port, set Port to 2.

Accordingly, the MS710C/D is switched to the internal circuit that corresponds to the type of set mixer.

(c) LOSS

Loss sets the mixer conversion loss.

The MS710C/D corrects the mixer conversion loss by switching the internal IF AMP GAIN according to the set value and displays the calibrated level.

If these values do not correspond to the mixer used, change them by using the SHIFT function.

When the [SHIFT] key is pressed, the SHIFT FUNCTION LIST is displayed on the CRT (see Fig. 4-17). To change the BIAS, press the [CENTER FREQ] key.

Thereafter, turn the data knob so that "BIAS: 0" is displayed on the CRT.

LOSS can be set similarly; however, at this time, the value can also be entered using the ten key pad.

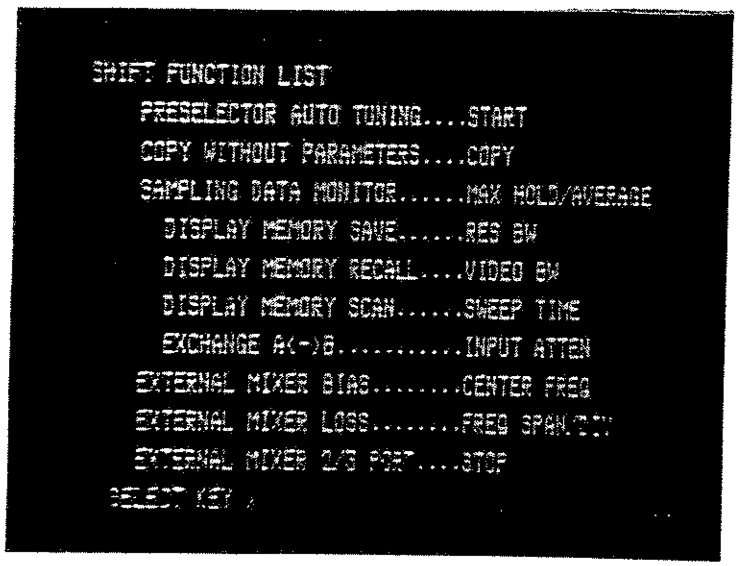



Fig. 4-17 Shift Function List

When SHIFT and STOP are pressed sequentially, PORT is switched sequentially between 2 PORT and 3 PORT.

These settings are stored even when the power is turned off, so they do not have to be reset each time the power is turned on.

(3) Connection

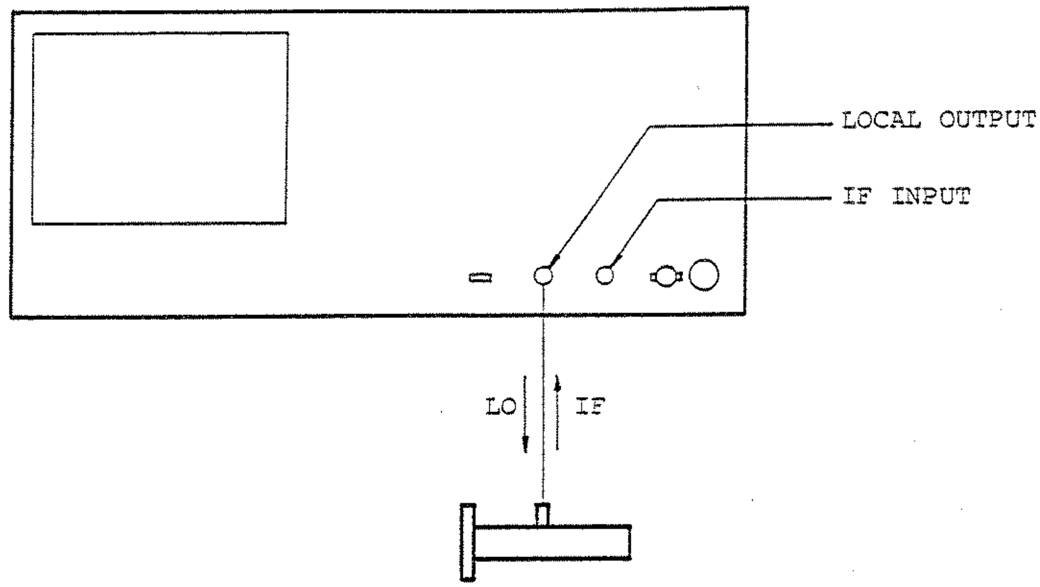



Fig. 4-18 2-port Mixer Connection

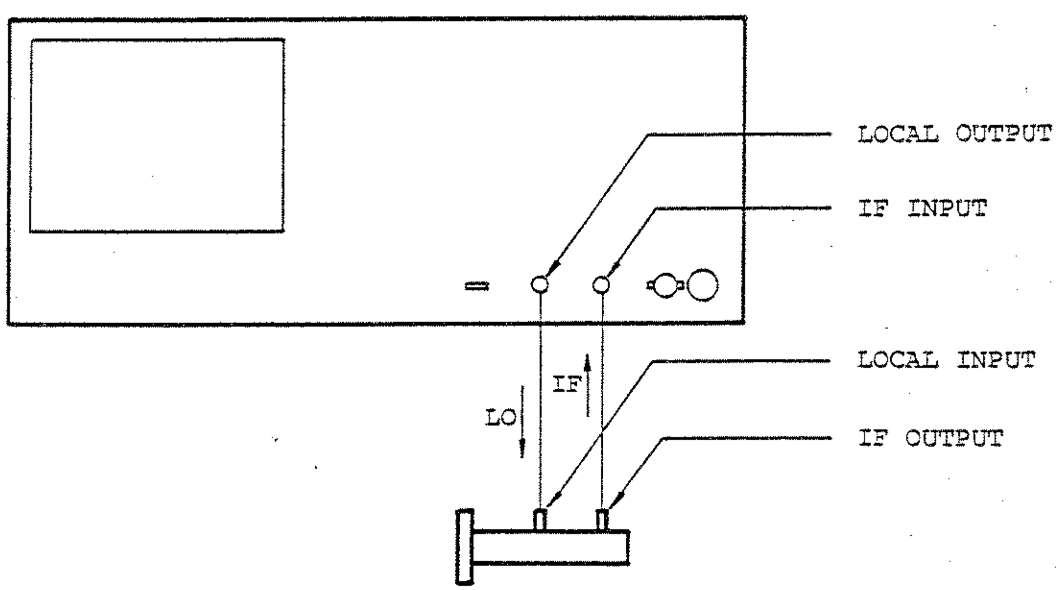



Fig. 4-19 3-port Mixer Connection

(4) Measurement

After frequency band and mixer parameters have been set, set the frequency range using [CENTER FREQ] key and [SPAN/DIV] key or [START] [STOP] keys, and set the measurement level using [REFERENCE LEVEL] key, as for the normal measurement procedure.

Since the REFERENCE LEVEL is corrected automatically by entering the mixer conversion loss correction value in advance, as previously described, the signal level can be read directly from the value displayed on the CRT even when an external mixer is used. Moreover, the signal frequency and signal level are also read with the marker as for the normal frequency band.

However, when using a bias-required mixer, for example, Tektronix 490 Series, adjust the bias so that the signal level is highest on the CRT as described in paragraph 4.15.1 (2).

Further, a false display cannot be avoided because of the image and multiple responses of the external mixer band. Therefore, check whether or not a signal is the true signal by using the [MODE CHANGE] key, as required.

The Mixing mode* + or - is switched alternately when the [MODE CHANGE] key is pressed. Only the spectrum with position that does not change each time the mixing mode is switched is the true signal. The current mixing mode is displayed at the top right corner of the CRT.

Measurement conditions setting and measured value reading like the above can also be remotely controlled by the GP-IB.

* Mixing mode:

The harmonic-mixer frequency-conversion basic equation is:

$$frf = \underline{n} \times f_{LO} \; \underline{\pm} \; f_{IF} \quad (F_{LO}\text{: 3 to 6 GHz; } f_{IF}\text{: 521.4 MHz})$$

The mixing mode (harmonic-conversion mode) is expressed by the combination of underlined n and ± in this equation. (ex. 10+, 16-)

(5) Measurement Examples

Let's measure a 33 GHz, -25 dBm signal, using a 26.5 to 40 GHz band external mixer as an example.

Figure 4-20 shows the 26.5 to 40 GHz full band sweep state after FREQ BAND No. 4 is set.

The true signal is displayed close to the left of the center scale line; however, many false displays are produced because of the multiple response.

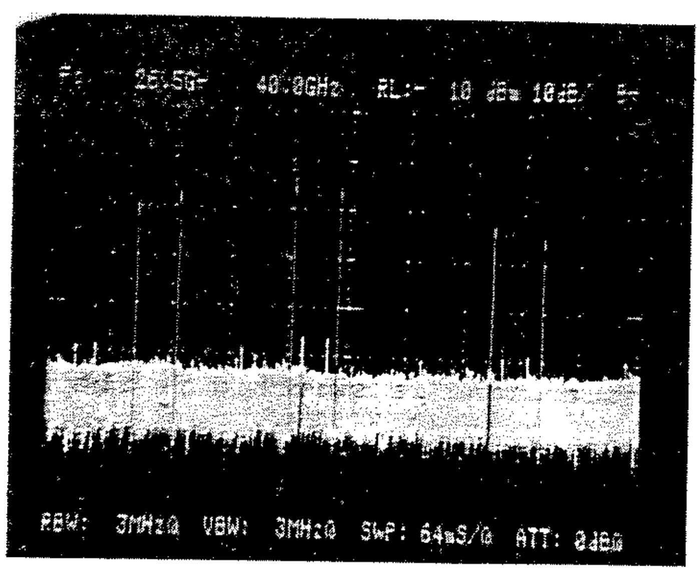


Fig. 4-20 26.5 to 40 GHz Band Initial Setting

When the [MODE CHANGE] key is pressed, the mixing mode is switched from 8- to 8+ as shown in Fig. 4-21. If you look closely, you will see that the false signal displays other than the true singal shift their display positions and levels.

However, with a wideband sweep like this, some shifts of false responses by MODE CHANGE is very small and it is difficult to distinguish between spectra. For example, the response displayed at the right side of the 2nd scale line from the left in Fig. 4-20 appears to shift very little even in Fig. 4-21.

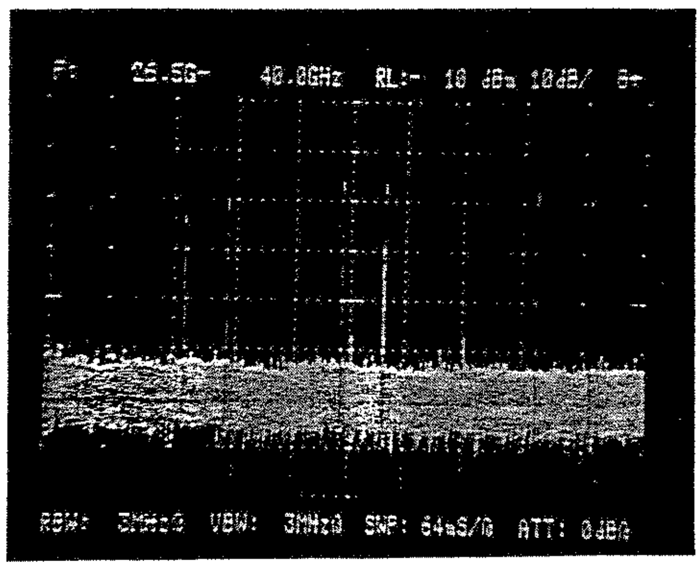



Fig. 4-21 Display after MODE CHANGE

In such a case, use of the marker function can be effective.

Figure 4-23 shows an example of MODE CHANGE performed after the marker is set (Fig. 4-22) to the response near the 2nd scale line from the left in the 8- mixing mode.

Though the shift of the false response on the CRT by this MODE CHANGE is small, it is clearly known with the aid of the marker.

It is obvious that the spectrum disappears at the former position by the marker level display change from -27.4 dBm to -62.8 dBm.

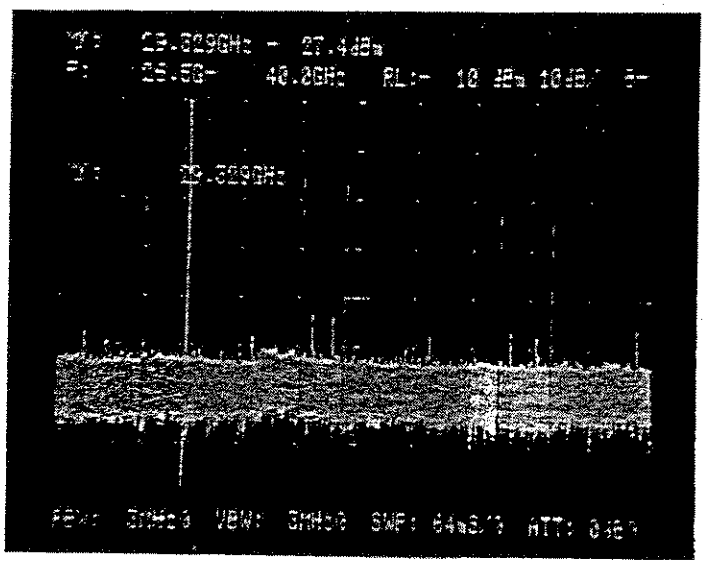


Fig. 4-22 False Display Identification by Marker (a)

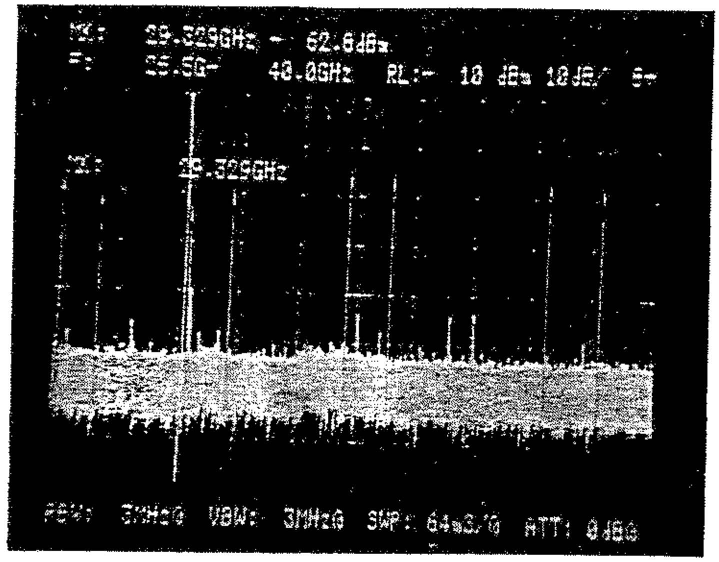



Fig. 4-23 False Display Identification by Marker (b)

Figure 4-24 shows the marker moved to a new display position. From this, it can be seen that the display position shifts to a 108 MHz higher position and the display level also changes substantially (-5.7 dB).

When the MODE CHANGE and marker functions are used in this way, a signal identification at such a wide-band sweep impossible with an ordinary signal identifier can be performed easily.

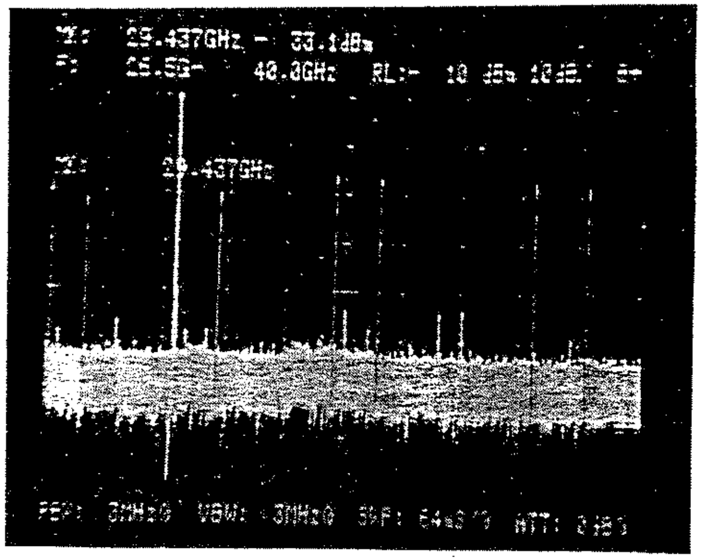



Fig. 4-24  False Display Identification by Marker (c)

Figures 4-25 and 4-26 show the display when the marker (NORMAL MARKER) is placed on the true signal and the MODE CHANGE is performed.  These displays show that level differs very little (only 0.5 dB) and each response is displayed at the same position (frequency) even in the MODE CHANGE mode.

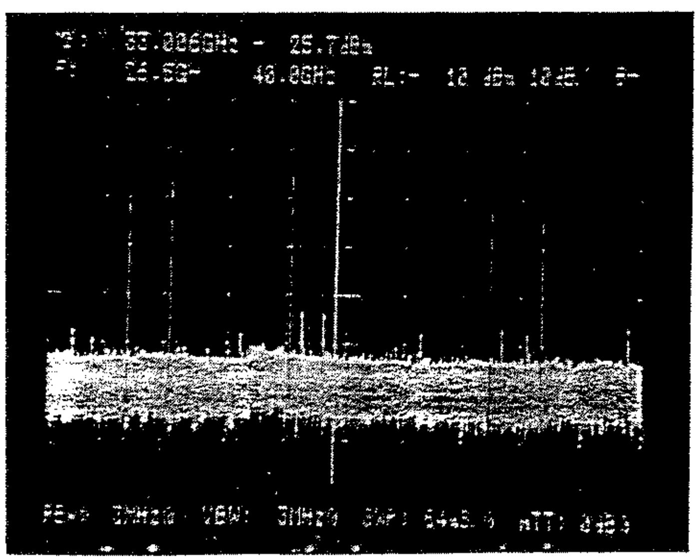


Fig. 4-25  Signal Identification by Marker (a)

It is easy to identify the difference if the marker intensity is decreased with the SCALE INTENSITY knob.

Thereafter, to observe the signal in more detail, fix the signal at the center by using the [MARKER] and [PEAK → CTR] keys and narrow the sweep width by using the SPAN [∨] key.

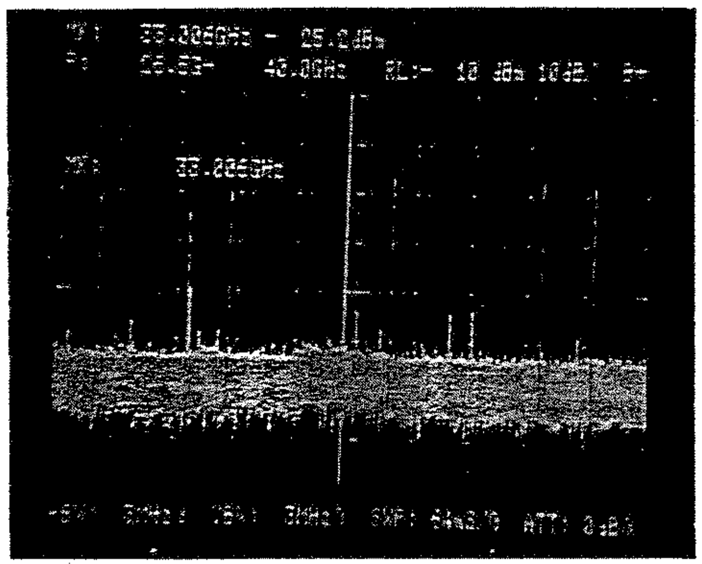


Fig. 4-26 Signal Identification by Marker (b)

Figures 4-27 and 4-28 show the shift of the spectra by using MODE CHANGE when the SPAN is narrowed to 400 MHz/div. The shift of the false signal is obvious and can be easily identified in this span width.

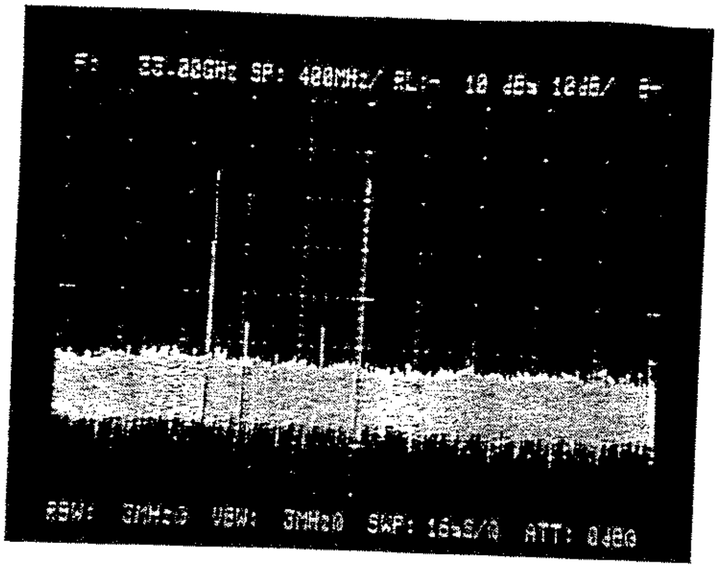



Fig. 4-27 MODE CHANGE at SPAN 400 MHz/div (a)

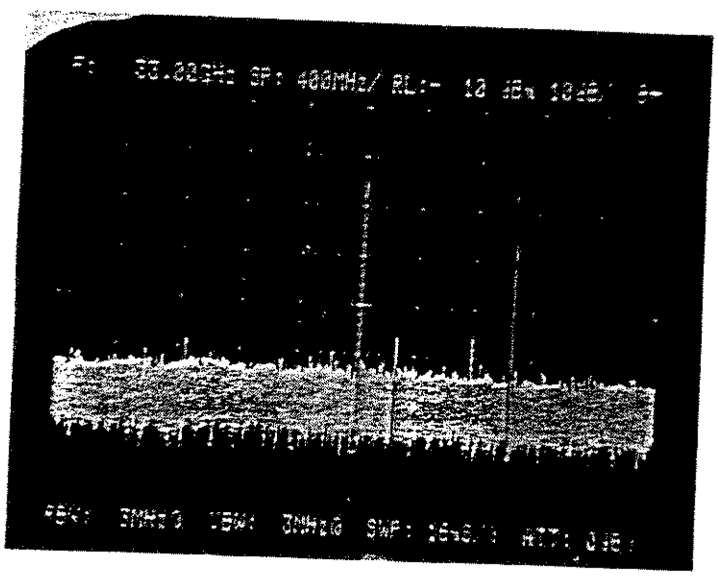


Fig. 4-28 MODE CHANGE at SPAN 400 MHz/div (b)

The 33 GHz signal, expanded by using the SPAN [∨] and [PEAK → CTR] keys, is shown in Fig. 4-29. Since the REFERENCE LEVEL is calibrated by entering the mixer conversion loss (29 dB in this example) beforehand, the signal level can be read directly from the CRT.

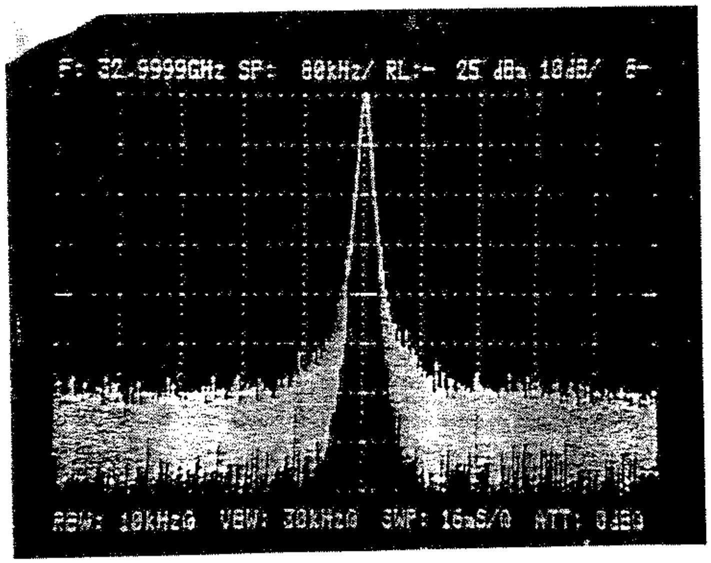



Fig. 4-29 Signal Display in the Narrow Span

In this way, the MS710C/D can efficiently measure spectra with an external mixer in the same way as with the internal mixer.

SECTION 5

GP-IB OPERATION

Section 5 explains the remote control functions of the MS710[ ] using the GP-IB.

## 5.1 Outline of GP-IB

The IEEE has specified the General Purpose Interface Bus (GP-IB) as the standard interface (IEEE-std 488-1978)*.

The following functions are possible using the GP-IB:

(1) The setting functions of the MS710[ ] can be remotely controlled by connecting it to a personal computer or controller. Measured data can be transferred to and from the computer.

(2) Information on the CRT can be output to a specified plotter or printer. (See paragraph 4.6).

Up to 15 devices can be connected to a GP-IB system. Even if the data transfer rates of the devices differ, data among the required devices can be transferred by address specification and a three-wire handshake process. Therefore, in combination with other measuring instruments, a more complicated measuring system can be configured around the computer**.

* Although this interface is electrically compatible with the standard interface specified by the International Electrotechnical Commission (IEC Pub 625), an adaptor is required for connection to devices with the IEC-specified standard interface, because the connector is not the same.

** Details of the GP-IB are given in a booklet "Introduction to the GP-IB System"; it is available upon request from Anritsu.

## 5.2 Interface Functions

The MS710[ ] has the interface functions listed in Table 5-1.

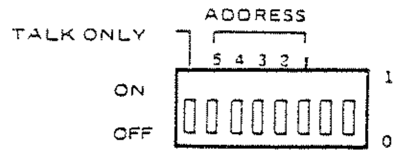
Table 5-1 MS710[ ] Interface Functions

| | |
|---|---|
| SH1 | All functions of the source handshake |
| AH1 | All functions of the acceptor handshake |
| T5 | Basic talker, serial poll, talk only mode, and talker release by My Listen Address (MLA) (All T functions) |
| L4 | Basic listener, listener release by My Talk Address (MTA). No listen only mode. |
| SR1 | All functions of serial poll |
| RL1 | All functions of remote and local |
| RP0 | No parallel poll function |
| DC1 | All functions of device clear |
| C0 | No controller function |

## 5.3 Before Using GP-IB

(1) Address

Up to 15 devices can be connected using a single GP-IB. To control the devices individually, each is given a unique number, which represents a GP-IB address.




The rear panel of the MS710[ ] has a switch, illustrated in the drawing above, for setting addresses. Settings are made by switches numbered from 1 to 5. ON and OFF corresponds to 1 and 0 in binary numbers.

If switches 1 and 2 are ON and the others are OFF, in binary notation, they are 00011, and in decimal notation, 3. Three is then the MS710[ ] address code.

Up to 31 numbers, from 0 to 30, can be used for the address, but number 31 (all switches from 1 to 5 ON) cannot be used because it has a special meaning (UNLISTEN or UNTALK) in the GP-IB system.

(2) TALK ONLY

The TALK ONLY switch is used to set the MS710[ ] in the talker state without any specification from the controller. Turn on the switch when making hard copies of the CRT image using a plotter or printer connected with the GP-IB. Otherwise, leave the switch OFF. (See paragraph 4.6.)

(3) BUS RESET

After the system has been set up, use the controller to execute interface clear (IFC). This resets the bus, and prevents unnecessary trouble.

(4) Remote/Local function

The MS710[ ] has all remote/local (RL) functions including local lockout. Therefore, ensure that the remote enable (REN) line is set "True" when program data are sent to the MS710[ ] for remote control.

## 5.4 Response to Device Clear and Device Trigger

When the MS710[ ] receives a device clear (DCL) or a selected device clear (SDC) command, it is reset to the same state as when power is turned on. When it receives a device trigger command, the sweep being executed is stopped, and the sweep is re-executed from the beginning. If it is in single trigger mode, only one sweep is started.

## 5.5 Device Messages

### 5.5.1 Outline

Device messages are units of data with one meaning, exchanged between devices of the system through the GP-IB.

The MS710[ ] is provided with device messages for setting or readout of setting values, and for I/O of waveform data. Device messages are handled in the same way as data input from the front panel manually.

(1) Data format

The data formats of the MS710[ ] device messages are classified into four types as shown in the following. ASCII codes (ISO 7-bit code) are used for each datum.

Type 1 Header + numeric data + unit

Type 2 Header + numeric data

Type 3 Header

Type 4 Header + character string

| | |
|---|---|
| Header: | Up to three alphabetic characters arranged to correspond to the front panel keys. |
| Numeric data: | Up to eight characters including signs and decimal points of signed integers format or signed real number format. |
| Unit: | Indicates a unit of numeric data. A prefix of a unit is acceptable. |
| Character string: | Up to 48 alphanumerics and symbols |

(2) Acceptable units

For the first type of data, when the input of the unit is omitted from the message, the basic unit for that header is assumed as the unit. When only G is input instead of GHz, it is valid for GHz. In cases where the unit is in both upper and lower case as in kHz, they are all assumed to be the same; KHZ or KHz are acceptable in place of kHz.

(3) Delimiter

A number of device messages can be transferred consecutively by delimiting each message with a comma. However, if the message is clearly delimited by the header, the comma can be omitted. At the end of a series of messages, an END message must be added by a line feed (LF) code or by an end or identify (EOI) line. Since some controllers add these codes automatically, refer to the controller manual.

### 5.5.2 Device messages and measurement conditions

Device messages (program data) for remote control of the MS710[ ] are listed in Table 5-2. When the MS710[ ] is specified as the listener, and data are sent in the formats given, all functions of the MS710[ ] can be placed under remote control. The device messages used by the controller for readout of the MS710[ ] setting conditions are given in Table 5-3. After the controller has sent the specified data shown on the left (program data with an O for OUT added to each header) to the MS710[ ], the controller can obtain the required setting information by specifying itself as the listener and the MS710[ ] as the talker.

(1) Messages used for setting measurement conditions

Table 5-2 Device Messages List I

| Header | Setting Contents | Input Format | Basic Unit |
|---|---|---|---|
| CF | CENTER FREQUENCY | CF n u | Hz |
| SP | FREQ SPAN | SP n u | Hz |
| FA | START FREQ | FA n u | Hz |
| FB | STOP FREQ | FB n u | Hz |
| RL | REFERENCE LEVEL | RL n u | dBm |
| BW | RES BW | BW n u | Hz |
| VB | VIDEO BW | VB n u | Hz |
| ST | SWEEP TIME | ST n u | s |
| AT | INPUT ATTEN | AT n u | dB |
| SV | SAVE | SV n | |
| RC | RECALL | RC n | |
| LG | LOG | LG n u | dB |
| LN | LIN | LN | |
| BA | FREQ BAND 1.7G-23G | BA | |
| BB | FREQ BAND 100K -2G | BB | |
| BC | FREQ BAND 10K-30M | BC | |
| BD | FREQ BAND 18G-26.5G | BD | |
| BE | FREQ BAND 22G-33G | BE | |
| BF | FREQ BAND 26.5G-40G | BF | |
| BG | FREQ BAND 40G-60G | BG | |
| BH | FREQ BAND 60G-90G | BH | |

n: Numeric data
u: Unit
c: Character data

Table 5-2 (Continued)

| Header | Setting Contents | Input Format | Basic Unit |
|---|---|---|---|
| BI | FREQ BAND 90G-140G | BI | |
| PC | PEAK → CTR | PC | |
| LS | (SIGNAL SEARCH) | LS | |
| RS | (SIGNAL SEARCH) | RS | |
| TI | TITLE | TI c | |
| AR | AUTO RES BW | AR | |
| AV | AUTO VIDEO BW | AV | |
| AS | AUTO SWEEP TIME | AS | |
| AI | AUTO INPUT ATTEN | AI | |
| TS | TRIGGER SINGLE | TS | |
| TF | TRIGGER FREE RUN | TF | |
| TL | TRIGGER LINE | TL | |
| TV | TRIGGER VIDEO | TV | |
| TE | TRIGGER EXT | TE | |
| WA | WRITE A | WA n | |
| WB | WRITE B | WB n | |
| RA | READOUT A | RA n | |
| RB | READOUT B | RB n | |
| AB | A-B | AB n | |
| CP | COPY | CP | |
| SU | SPAN UP ⋀ | SU | |
| SD | SPAN DOWN ⋁ | SD | |

n: Numeric data
u: Unit
c: Character data

Table 5-2 (Continued)

| Header | Setting Contents | Input Format | Basic Unit |
|---|---|---|---|
| PP | PRESELECTOR PEAK | PP | |
| RQ | SERVICE REQUEST ON/OFF | RQ n | |
| NM | NORMAL MARKER | NM n u | Hz |
| DM | DELTA MARKER | DM n u | Hz |
| PM | PEAK MARKER | PM | |
| MC | MARKER → CENTER | MC | |
| MO | MARKER OFF | MO | |
| MA | MARKER ON MEMORY A | MA | |
| MB | MARKER ON MEMORY B | MB | |
| MM | MIXING MODE MINUS | MM | |
| MP | MIXING MODE PLUS | MP | |
| XB | EXTERNAL MIXER BIAS | XB n | |
| XL | EXTERNAL MIXER LOSS | XL n u | dB |
| XP | EXTERNAL MIXER 2/3 PORT | XP n | |
| DS | SAVE DISPLAY DATA | DS n | |
| DR | RECALL DISPLAY DATA | DR n | |
| DQ | SCAN DISPLAY DATA | DQ n | |
| DX | EXCHANGE DATA A ⇄ B | DX | |

n: Numeric data
u: Unit
c: Character data

(2) Messages used for readout of measurement conditions

Table 5-3 Device Messages List II

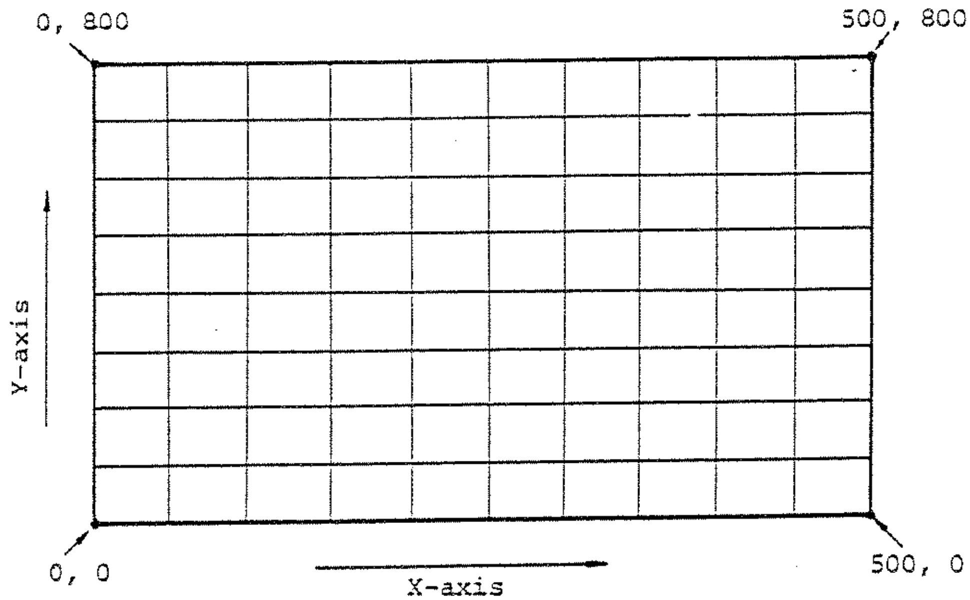
| Output Specifying Data | Output Contents | Output Format |
|---|---|---|
| OCF | CENTER FREQUENCY | CF n u |
| OSP | FREQ SPAN | SP n u |
| OFA | START FREQ | FA n u |
| OFB | STOP FREQ | FB n u |
| ORL | REFERENCE LEVEL | RL n u |
| OSC | SCALE | LG n u or LN |
| OBW | RES BW | BW n u |
| OVB | VIDEO BW | VB n u |
| OST | SWEEP TIME | ST n u |
| OAT | INPUT ATTENUATION | AT n u |
| ORCn | Condition setting memory | Output character strings delimiting each function using a comma |
| OTXn | Character information on CRT | Character string on CRT |
| OMn | MARKER INDICATION | M n u |
| OHM | HARMONIC MODE | HM n |
| OXB | EXTERNAL MIXER BIAS | XB n |
| OXL | EXTERNAL MIXER LOSS | XL n u |
| OXP | EXTERNAL MIXER 2/3 PORT | XP n |

n: Numeric data
u: Unit

CR and LF codes are added to the end of each output data, and when an LF code is issued, an END message by EOI line is sent simultaneously.

### 5.5.3 Device messages for waveform memory information

CRT Display Coordinates



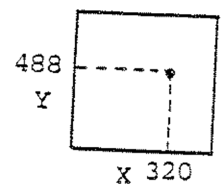

Within the graticules range, there are a total of 501 X-axis values (0 to 500; 50 points per division) and 801 Y-axis values (0 to 800; 100 points per division). Y-axis over-range is available up to 999.

Programming data including the header "TA" corresponds to waveform memory A and the data including the header "TB" corresponds to waveform memory B.

(1) Message: TA / TB X-data, Y-data

This is used to send the waveform data to the MS710[ ] from a computer, point by point. X- and Y-data locate the horizontal and vertical position the CRT, respectively. Each data format consists of 3 digits from 0 to 9.

Example: TA 320, 488

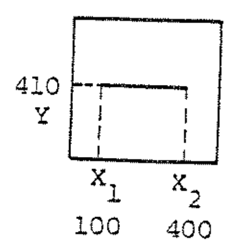



(2) Message: LTA / LTB Y-data, $X_1$-data, $X_2$-data

This is used to write a horizontal line on the CRT at the vertical position of the Y-data and the horizontal position from $X_1$-data to $X_2$-data. Each data format consists of 3 digits from 0 to 9.

This is convenient for writing a horizontal line, such as a specification line, on the CRT quickly.

Example: LTB 410, 100, 400



(3) Message: LTA / ITB Y-data 0, Y-data 1, Y-data 2, -------- --------, Y-data 500

This is used to send all the sequential Y data from X=0 to X=500, to the waveform memory. Each Y-data format is a 3-digit decimal. If the number of Y-data are less than 501, the data are valid as the first number of data from X=0.

| Data address | X | 0 | 1 | 2 | 3 | 4 | 5 | 6 | ---------- | 497 | 498 | 499 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Data | Y | $Y_0$ | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ | $Y_5$ | $Y_6$ | --------- | $Y_{497}$ | $Y_{498}$ | $Y_{499}$ | $Y_{500}$ |

(4) Message: OTA / OTB (,) format specification (,) data point specification

This message is used to specify the output data format which are sent to the listener or controller when the MS710[ ] is the talker.

Format specification:

Alphabet O plus one digit number; On (n = 1 to 3)

O1: Sends the numeric value of Y-axis from 0 to 800, which indicates the data position, as a 3-digit deciaml numerals format.

O2: Sends the same value as O1 in a 2-byte binary format (in order of high-order to low-order).

O3: Sends the Y data in dBm units.

Error if LOG scale is not being used. When PK is specified, the horizontal axis data is a 3-digit decimal.

Data point specification:

Pn: (n=0 to 500)
Sends the n-th data of the 501 points on the X-axis.

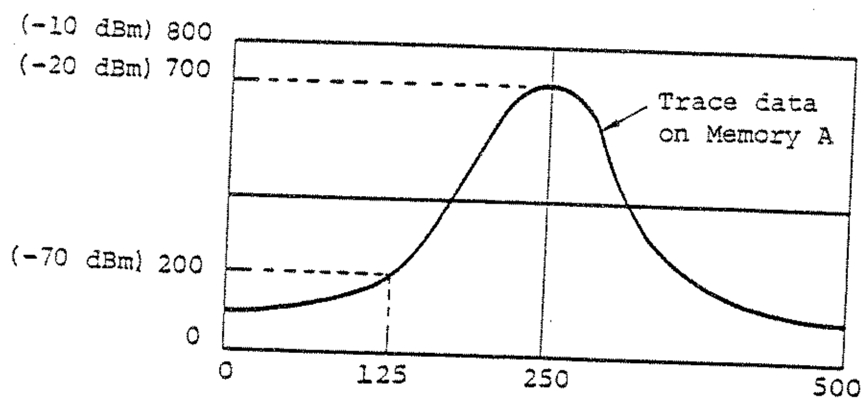
AL: Sends all the data of the 501 points in order on the X-axis.

PK: Sends the X-axis (point) and Y-axis (data) positions of the highest data.

Example:

REFERENCE LEVEL -10 dBm

SCALE LOG 10 dB/div



Assuming the above measurement conditions and waveform:

Output Data Format

| | |
|---|---|
| 2 0 0 CR LF (EOI) | if OTA, O1, P125 |
| 00 C8 (EOI) | if OTA, O2, P125 |
| - Δ 7 0 . 0 0 CR LF (EOI) | if OTA, O3, P125 |
| 2 5 0 , - Δ 2 0 . 0 0 CR LF (EOI) | if OTA, O3, PK |
| 1 0 0 , 1 0 0 , 1 0 1 , ... | if OTA, O1, AL |

## 5.6 Service Requests

The MS710[ ] sends a service request message and requests serial polls from the controller in the following cases. The cause of the service request can be confirmed by reading the status byte.

1. When the program data received through the GP-IB are inappropriate.

2. When a single sweep started by TS or device trigger in the TRIGGER SINGLE mode is completed and data are ready for output.

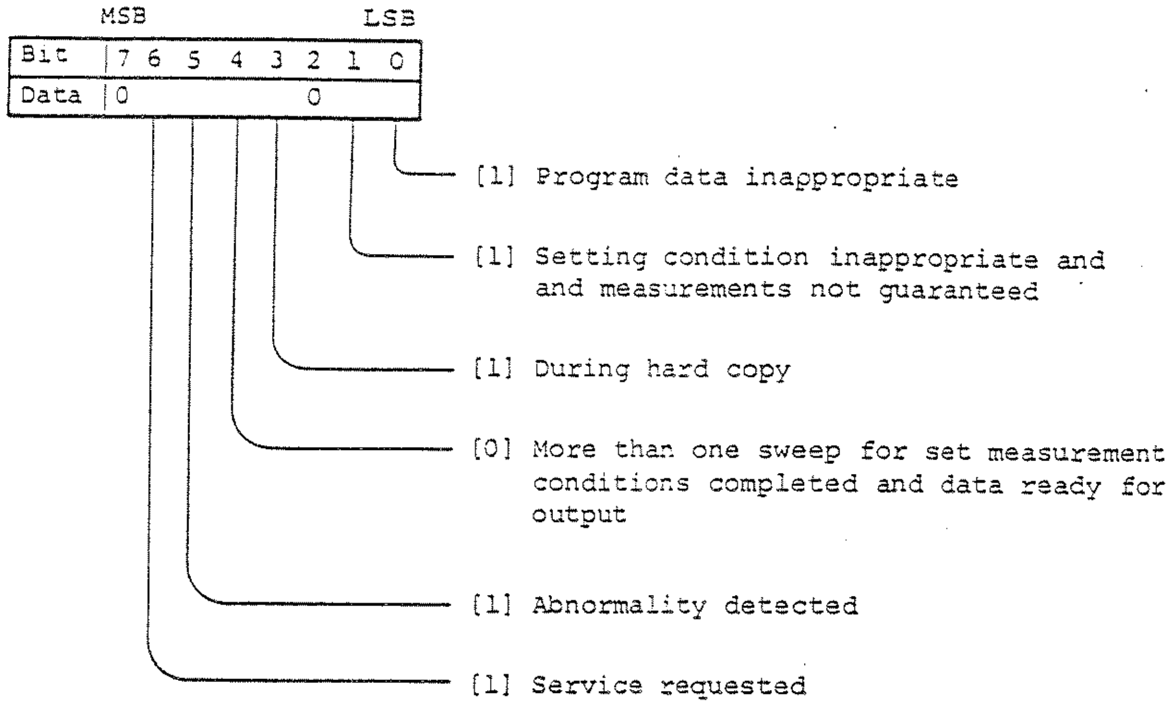
3. When a hard copy is completed.

4. When the device is operating abnormally. (Checked by the self-test routine.)

Note:

The service request function can be switched ON and OFF. The initial state after power on is OFF. Thus, to enable this function, the program code "RQ1" must be sent to the MS710[ ] beforehand. See paragraph 5.7.10(4).

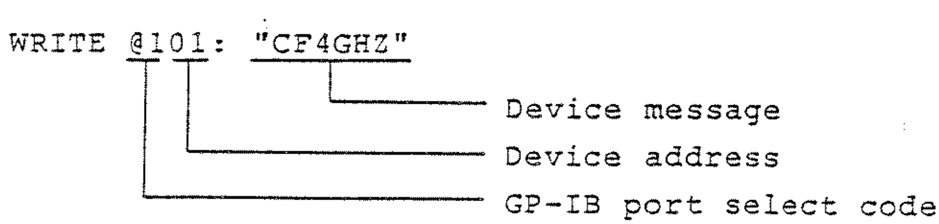
Each bit of the status byte has the following meaning:




## 5.7 GP-IB Operation Examples

The programs in the following examples are written in the BASIC language used by the Personal Technical Computer Packet III/IIIs.

In the Packet III/IIIs, data messages can be sent to each device using the following commands:



In the above example, character-string data CF4GHz is sent to the device whose address has been specified as 1 (in all examples in this section, the MS710[ ] address is assumed to be 1).

To read the data from each device, execute

READ @101: A$

The data sent from the device whose address is 1 are written in the string variable, A$.

### 5.7.1 FREQUENCY #1 device messages

(1) FREQ BAND 1.7 G - 23 G

Band selection ------ BA

(2) FREQ BAND 100K - 2G

Band selection ------ BB

(3) FREQ BAND 10K - 30M (MS710C only)

Band selection ------ BC

When these three codes are sent to the MS710[ ], all measurement parameters are initialized in that band as if the front panel keys had been pressed. An example is given below:

WRITE @101: "BA"

This indicates that the 1.7 to 23 GHz frequency band is initialized.

(4) CENTER FREQUENCY

Data setting ------ CF Numeric data Unit

Data reading --- OCF

(5) SPAN

Data setting ------ SP Numeric unit
SU (span up ⩓ )
SD (span down ⩔ )
Data reading --- OSP

(6) START

Data setting ------ FA Numeric data Unit
Data reading --- OFA

(7) STOP
Data setting ------ FB Numeric data Unit
Data reading --- OFB

The units can use both upper and lower case characters.

All these codes can be used in the same way, for example, to set the CENTER FREQUENCY to 12.345 GHz, execute:

```
WRITE @101: "CF12.345GHz"
```

After execution of the above command, when

```
WRITE @101: "OCF"
READ  @101: A$
```

are executed, the CENTER FREQUENCY data are written in the string variable A$ as character-string "CF12.345 GHz".

### 5.7.2 LEVEL #8 device messages

(1) REFERENCE LEVEL

Data setting ---- RL Numeric data Unit
Data reading ---- ORL

The REFERENCE LEVEL unit is dBm and can be written either as "DBM", "dBm" or "dbm". It can also be omitted.

To set the REFERENCE LEVEL to -12 dBm, execute

WRITE @101: "RL-12DBM"

When the REFERENCE LEVEL is -12 dBm, and

WRITE @101: "ORL"
READ @101: A$

are executed, the contents of the REFERENCE LEVEL are written in the string variable A$ as character-string "RL-12DBM".

(2) Selection of the LOG/LIN scale

Data setting --- LG Numeric data Unit / LN
Data reading --- OSC

When a LOG scale is used, 10/5/2/1 can be selected as the four numeric data. Upper and lower case characters in the unit are not differentiated. When a LINEAR scale is used, the numeric data and units are not required. To confirm the state when the scale is set in LINEAR, execute

WRITE @101: "OSC"
READ @101: A$

"LN", indicating the LINEAR scale, should then be in A$.

### 5.7.3 SIGNAL SEARCH device messages

Message: PC (PEAK → CTR)
LS (《)
RS (》)

PC (PEAK → CTR). LS (《), and RS (》) operate each time their codes are sent, for example, to perform the PEAK → CTR operation, execute

WRITE @101: "PC"

When PEAK → CTR is to be performed consecutively, ensure that the timing is adjusted so that the next operation can be executed after the previous one is completed.

### 5.7.4 DISPLAY #43 device messages

Message:

```
WA0  (WRITE A  OFF)
WA1  (WRITE A  NORMAL)
WA2  (WRITE A  MAX HOLD)
WA3  (WRITE A  AVERAGE)

WB0  (WRITE B  OFF)
WB1  (WRITE B  NORMAL)
WB2  (WRITE B  MAX HOLD)
WB3  (WRITE B  AVERAGE)

RA0  (READOUT A  OFF)
RA1  (READOUT A  ON)

RB0  (READOUT B  OFF)
RB1  (READOUT B  ON)

AB0  (A-B  OFF)
AB1  (A-B  REF LINE TOP)
AB2  (A-B  REF LINE MID)
AB3  (A-B  REF LINE BTM)
```

To change writing to and display of memory A to writing to and display of memory B in the NORMAL mode, execute

```
WRITE @101:  "RA0, WB1"
```

In the same way as inputting from the keyboard, the WB1 command turns READOUT B on automatically; it is not necessary to add "RB1".

5.7.5 COPY #35 device messages

Message: CP

When a COPY operation is to be executed by this command, the MS710[ ] and the printer or plotter must be connected by the parallel interface. If the printer and plotter are connected by the GP-IB containing a controller, they will not operate because the MS710[ ] must be in TALK ONLY to output at the printer or plotter by GP-IB. However, when the MS710[ ] is in TALK ONLY, it cannot receive data from the controller.

5.7.6 MEMORY #32 device messages

Message: SVn (SAVE n = 1 to 9)

RCn (RECALL n = 0 to 9)

ORCn (Information on condition setting memory n = 0 to 9)

The information on the condition setting memory is output as follows:

```
WRITE @101:  "ORC1"
READ  @101:  A$
```

When these are executed, the contents of memory 1 are written to A$, which must have an area sufficient for 250 characters. The length of the input character-string depends on the set values. See paragraph 5.8 for data format.

5.7.7 COUPLED FUNCTION #24 device messages

(1) RES BW

Data setting --- BW Numeric data Unit

Data reading --- OBW

AUTO setting --- AR

The numeric data must be in steps of 1, 3, and 10.

(2) VIDEO BW

Data setting --- VB Numeric data Unit
Data reading --- OVB
AUTO setting --- AV

The numeric data must be in steps of 1, 3, and 10.

(3) SWEEP TIME

Data setting --- ST Numeric data Unit
Data reading --- OST
AUTO setting --- AS

The following SWEEP TIME units are acceptable:

ms: mSEC, MSEC, msec
μs: uSEC, USEC, usec

Be careful that msec and MSEC are considered to be the same unit. When the units are omitted, "sec" is assumed.

(4) INPUT ATTEN

Data setting --- AT Numeric data Unit
Data reading --- OAT
AUTO setting --- AI

The dB unit is acceptable as DB, dB, or db. The numeric data are the numeric values of the 10 steps from 0 to 70, and the units may be omitted. For example, if settings are to be executed for RES BW: 100 kHz, VIDEO BW: 10 kHz, SWEEP TIME: AUTO and INPUT ATTEN: 20 dB, execute as follows:

WRITE @101: "BW100KHz, VB10KHz, AS, AT20DB"
or WRITE @101: "BW100K, VB10K, AS, AT20"

This is an example for sending four device messages consecutively.

### 5.7.8 SWEEP TRIGGER #36 device messages

Message: TS (SINGLE)
TF (FREE RUN)
TL (LINE)
TV (VIDEO)
TE (EXT)

The trigger level in VIDEO and EXT cannot be controlled using the GP-IB.

### 5.7.9 MARKERs device messages

Messages for Marker Setting --- NM Numeric data Unit (Normal Marker)
DM Numeric data Unit (Delta Marker)
PM (Peak Marker)
MC (Marker → Center)
MO (Marker Off)

Messages for Marker Reading --- OM1 (Normal marker frequency)
OM2 (Normal marker level)
OM3 (Delta marker frequency)
OM4 (Delta marker level)
OM5 (Peak marker frequency)
OM6 (Peak marker level)

To set the normal marker at 4.521 GHz, execute

```
WRITE @101: "NM 4.521 GHZ"
```

Then, if the next program lines

```
WRITE @101: "OM2"
READ @101:  A$
```

were executed, the level at the marker frequency will be written in the string variable A$ as follows.

"M2-Δ21.50 dBm"

See paragraph 5.8 for other data formats.

### 5.7.10 Other device messages

(1) Title

Message: TI Character-string

The length of the character-string can be up to 48 characters.

When

```
WRITE @101: "TIANRITSU"
```

is executed, "ANRITSU" is displayed on the title line.

(2) Output of the character information on CRT

Message: OTXn (n = 1 to 4 or not specified)

```
WRITE @101: "OTX"
READ  @101: A$
```

When the above is executed, all character information on the CRT is written to A$, which must have enough area for 202 characters.

The position of the character-string on the CRT is indicated by n.

n = 1: Title line

n = 2: Setting conditions above the scale

n = 3: Function during setting that appears on the scale and information on error messages, etc.

n = 4: Setting conditions under the scale

If n is omitted, all data of n = 1 to 4 are output continuously.

(3) Preselector autotuning

Message: PP

This command starts autotuning of the preselector as if panel operation of [SHIFT] + C[START] is executed.

It is effective only when a frequency band of 1.7 to 23 GHz, and span of less than 50 MHz/div, is used.

(4) Service request on and off

Message: RQ0

After this message is received, a service request is not generated. When a service request has already been generated, it is reset and further generation of service requests is inhibited.

Message: RQ1

Reception of this message, resets the state in which the generation of service request is inhibited by "RQ0" message.

(5) Messages for EXTERNAL MIXER #72 (MS710C/D only)

Message: BD to BI

These messages are used to select the desired external mixer band. See Table 5-2 for the frequency range in each band.

Message: MM, MP and OHM

MM and MP are used to change the mixing mode (upper local or lower local) for the external mixer.

MM --- lower to upper
MP --- upper to lower

The current harmonic mixing mode can be readout by using the "OHM" message (See paragraph 5.8.1). Although the "MM" and "MP" are effective only for the external mixer bands, the "OHM" can be used for all frequency bands.

Message: XBn and OXB

The bias source for an external mixer is set by "XBn" message. As the manual setting, the range for n is from -100 to +100 and this corresponds to the bias current from -16 mA to +16 mA.

The current bias setting can be readout by using the "OXB" message. (See paragraph 5.8.1)

Message: XLn (dB) and OXL

XLn is used to input the external mixer loss for the correction of reference level. The range for n is from 18 to 99 and the set value can be read by using the OXL message. (See paragraph 5.8.1)

Message: XPn and OXP (n: 2 or 3)

XP2 specifies a 2 port mixer.

XP3 specifies a 3 port mixer.

The mixer type used can be read by using OXP message.

## 5.8 Data Format

### 5.8.1 Data format for GP-IB readout

Δ: Blank

| Output Specifying Data | Output Contents | Output Data Format |
|---|---|---|
| OCF* | CENTER FREQ | CF numeric data Hz<br>numeric data: 8 Characters; Hz: Suffix (M or G)<br>(Example) ΔΔΔΔ10.0MHz, ΔΔ2000.0MHz } 100K-2GHz BAND<br>ΔΔΔ1.700GHz, ΔΔ23.000GHz } 1.7G-23GHz BAND |
| OSP* | SPAN | SP Numeric data Hz/<br>Numeric data: 4 Characters; Hz/: Suffix (M or k)<br>(Example) Δ200MHz/<br>20.0kHz/<br>0.50MHz/ |
| OFA*<br>OFB* | START FREQ<br>STOP FREQ | FA Numeric data Hz<br>Numeric data: 8 Characters; Hz: Suffix (M or G)<br>FB Numeric data Hz<br>Numeric data: 8 Characters; Hz: Suffix (M or G)<br>(Example)<br>Same as CENTER FREQ |
| ORL | REFERENCE LEVEL | RL sign Numeric data dBm<br>sign 5 Characters<br>(Example) +ΔΔ30Δ dBm<br>-109.0 dBm |
| OSC | SCALE | LG Numeric data dB/ (for LOG scale)<br>10 Δ5 Δ2 Δ1<br>LN (for Linear scale) |

Δ: Blank

| Output Specifying Data | Output Contents | Output Data Format |
|---|---|---|
| OBW | RES BW | BW Numeric data ␣ Hz<br>3 Characters — Suffix (Δ, M or k)<br><br>(Example) ΔΔ3MHz<br>300kHz |
| OVB | VIDEO BW | VB Numeric data ␣ Hz<br>3 Characters — Suffix (Δ, M or k)<br><br>(Example) ΔΔ3MHz<br>100kHz<br>100ΔHz |
| OST | SWEEP TIME | ST Numeric data ␣ S/<br>3 Characters — Suffix (Δ, m, or u)<br><br>for START/STOP operation<br>ST ****** |
| OAT | INPUT ATTEN | AT Numeric data dB<br><br>Δ 0  1 0 2 0 ..... 7 0 |
| ORCn (n=0 to 9) | MEMORY 0 to 9 | See paragraph 5.8.2 |
| OTXn (n=1 to 4) | Characters on CRT Display | Character stream in nth line of CRT Display<br><br>50 Characters |
| OTX | Characters on CRT Display | All character stream on the CRT Display (line 1 to 4)<br><br>200 Characters<br><br>See paragraph 5.8.3 |

Δ: Blank

| Output Specifying Data | Output Contents | Output Data Format |
|---|---|---|
| OMn n=1 | Normal Marker Freq. | M1 Numeric data Suffix Hz<br>8 Characters |
| n=2 | Normal Marker Level | M2 Sign Numeric data dBm (for LOG scale)<br>6 Characters<br>M2 Sign Numeric data Suffix V (for LIN scale)<br>6 Characters |
| n=3 | Delta Marker Freq. | M3 Sign Numeric data Suffix Hz<br>7 Characters |
| n=4 | Delta Marker Level | M4 Sign Numeric data dB (for LOG scale)<br>6 Characters<br>M4 Sign Numeric data Suffix V (for LIN scale)<br>6 Characters |
| n=5 | Peak Marker Freq. | M5 Numeric data Suffix Hz<br>8 Characters |
| n=6 | Peak Marker Level | M6 Sign Numeric data dBm (for LOG scale)<br>6 Characters<br>M6 Sign Numeric data Suffix V (for LIN scale)<br>6 Characters |
| OHM | MIXING MODE | HM Numeric data (2 Characters) sign (+ or -)<br>(Example) Δ1-<br>16+ |
| OXB | EXTERNAL MIXER BIAS | XB sign Numeric data (3 Characters)<br>(Example) -Δ25 |
| OXL | EXTERNAL MIXER LOSS | XL Numeric data dB<br>3 Characters<br>(Example) ΔΔ0dB<br>Δ42dB |
| OXP | EXTERNAL MIXER 2/3 PORT | XP2 (for 2 port mixer)<br>or XP3 (for 3 port mixer) |

At the end of each data stream, a "$C_R L_F$" code is added. Simultaneously with the output of "$L_F$", the end message using the EOI line is also output.

* When "OCF" or "OSP" in the START/STOP mode, or "OFA", or "OFB" in the CENTER/SPAN mode are specified, one "?" character is output.

5.8.2 Data format for ORCn

(1) START/STOP mode

The data stream for the following data is output in this order.

Frequency Band (one from BA to BI)

Start Frequency (FA)

Stop Frequency (FB)

Reference Level (RL)

Scale (LG or LN)

Resolution BW (BW)

Video BW (VB)

Sweep Time (ST)

Input Attenuator (AT)

(2) CENTER/SPAN mode

Same as (1) except the two "FA" and "FB" data are replaced by

Center Frequency (CF) and

Span (SP)

(3) When the memory number where no condition data are stored is specified, one "?" character is output.

(4) Examples

```
BA,FA   1.700000GHz,FB  23.000000GHz,RL+  0.0dBm,LG10dB/,BW  3MHz,
VB  3MHz,ST       ,AT10dB

BA,CF  12.350000GHz,SP     200.000MHz/,RL- 30.0dBm,LG 5dB/,BW  3MHz,
VB  3MHz,ST 10mS/,AT10dB

BB,FA          0kHz,FB   2.000000GHz,RL+  0.0dBm,LG10dB/,BW  3MHz,
VB  3MHz,ST       ,AT30dB

BB,CF   1.000000GHz,SP     200.000MHz/,RL+  0.0dBm,LG10dB/,BW  3MHz,
VB  3MHz,ST 10mS/,AT30dB

BC,FA          0kHz,FB     30.000MHz,RL- 25.0dBm,    LIN,BW100kHz,
VB300kHz,ST       ,AT10dB

BC,CF      15.000MHz,SP      3.000MHz/,RL+  0.0dBm,LG10dB/,BW100kHz,
VB300kHz,ST 10mS/,AT30dB

BI,FA  89.910000GHz,FB 140.090000GHz,RL- 10.0dBm,LG10dB/,BW  3MHz,
VB  3MHz,ST       ,AT 0dB

BI,CF 115.000000GHz,SP   5.018000GHz/,RL- 10.0dBm,LG10dB/,BW  3MHz,
VB  3MHz,ST234mS/,AT 0dB
```

## 5.8.3 Data format for OTX (n)

```
       0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49

        [------------------------------- Title 48 characters -------------------------------]
        Δ M : ± [            ]G H z Δ ± [1 0 8 .9 9]d B Δ Δ Δ [      Title 20 characters      ]
n = 1   M K :                                      d B m
                                                   m V Δ

       Δ F : [          ]k - [          ]k H z Δ Δ Δ R L : ± [1 0 0 .1]d B m Δ 1 0 d B / Δ 5 6 +
n = 2                                                B T
                                                     T P                        L I N
                                                     M D
       Δ F : [          ]k H z Δ S P : [    ]M H z / Δ

n = 3  Δ S T A R T : [1 2 .3 4 5 6 7 G H z]                                     [U N C A L]Δ Δ *

n = 4  Δ R B W : 3 0 0 k H z @ Δ Δ V B W : 3 0 0 k H z @ Δ Δ S W P : 1 0 0 m S / @ Δ Δ A T T : 1 0 d B @
```

SECTION 6

PRINCIPLES OF OPERATION

## 6.1 General

The MS710[ ] is a superheterodyne swept front end type Spectrum Analyzer. The block diagram of the entire system is shown in Fig. 6-1.

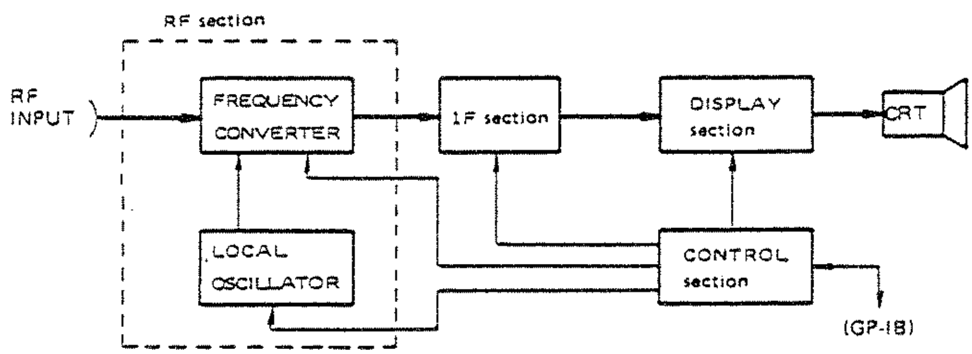



Fig. 6-1 MS710[ ] Block Diagram

The RF input is converted to an IF frequency by the mixer of the frequency converter in the RF section. The signal detected while passing through the IF section is stored in the digital storage memory of the display section. This stored signal level is displayed on the screen in frequency domain. The horizontal axis indicates the frequency while the vertical axis indicates the level. All sections are controlled by the control section with a built-in microcomputer.

## 6.2 RF Section

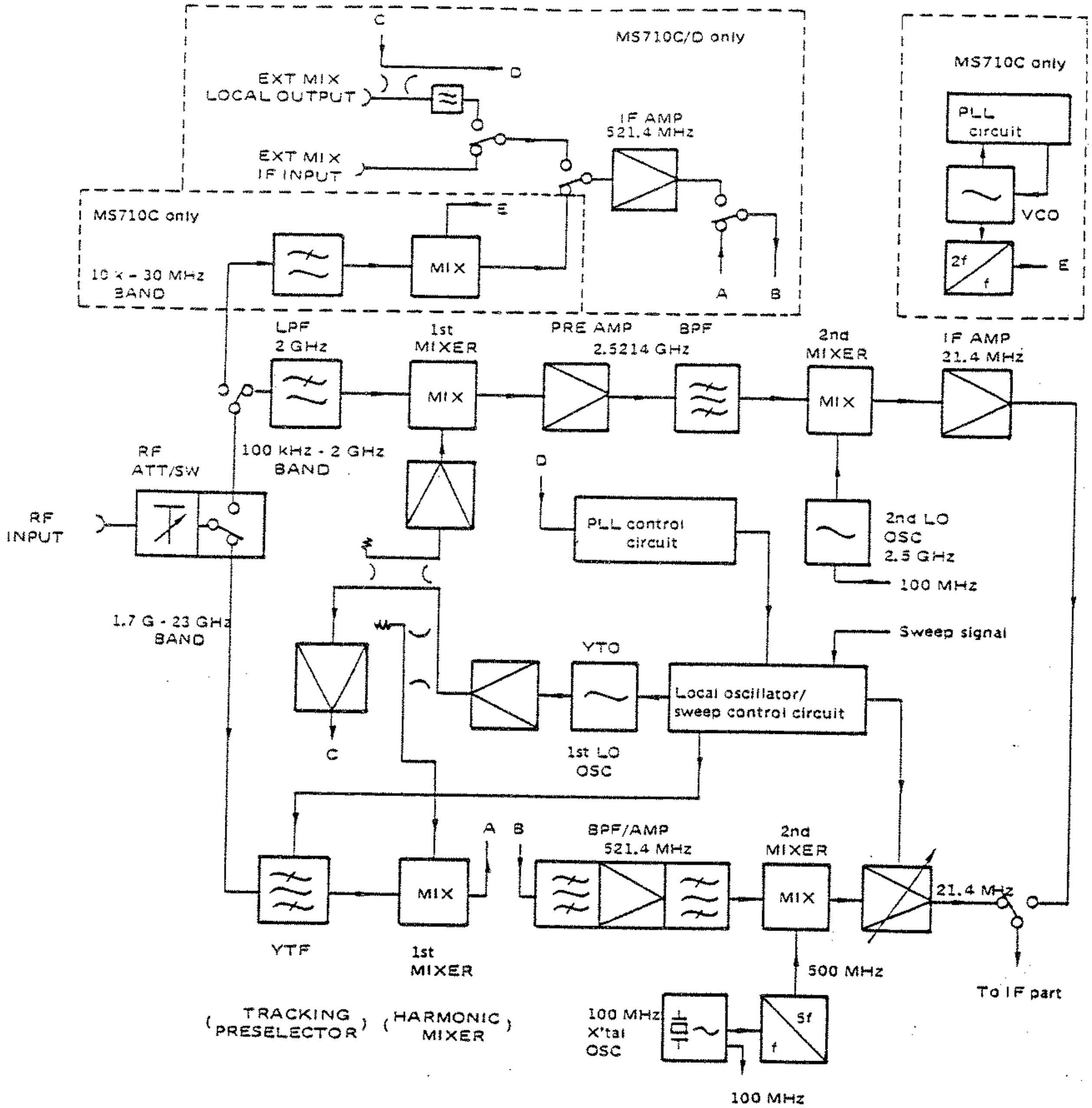



Fig. 6-2 RF Section Block Diagram

The input signal, after passing the RF ATT, is divided into two paths by the RF switch which is controlled by the BAND selector switch.

The 100 kHz to 2 GHz band input signal enters the 1st MIXER after passing through the 2 GHz LPF preselector where it is mixed with the 1st LOCAL signal of 2.5214 to 4.5214 GHz and converted into the 1st IF signal of 2.5214 GHz. The 1st IF signal, after it passes through the PREAMP and BPF, is mixed with the 2nd LOCAL signal of 2.5 GHz in the 2nd MIXER and becomes the 21.4 MHz IF signal.

The 1.7 to 23 GHz band input signal is input to the 1st MIXER after passing through the YIG tuned filter (YTF) preselector. Since the 1st LOCAL OSC (YTO: YIG tuned oscillator) can oscillate only at a frequency of 2.2 to 6 GHz, to cover the 1.7 to 23 GHz range, the frequency is harmonically mixed with an appropriate frequency of the local signal in the 1st MIXER and converted to the 1st IF signal of 521.4 MHz. The 1st IF signal, after passing through the BPF and AMP, is mixed in the 2nd MIXER with the 2nd LOCAL signal of 500 MHz, which is multiplied to five times the 100 MHz crystal oscillator output and emerges as the 21.4 MHz IF signal.

The 21.4 MHz IF signal enters the variable gain amplifier to compensate for the difference of conversion loss due to the different (1 to 4) harmonic numbers used by the harmonic mixer, and is frequency-characteristic corrected.

The IF signal of each frequency band is selected by a switch coupled with the RF switch and sent to the IF section.

The RF section also contains a control circuit for setting and sweeping the 1st LOCAL frequency, a phase lock loop (PLL) control circuit for frequency stabilization, and an amplifier and distribution circuits for the 1st LOCAL signal.

## 6.3 IF Section

The IF section block diagram is shown in Fig. 6-3.

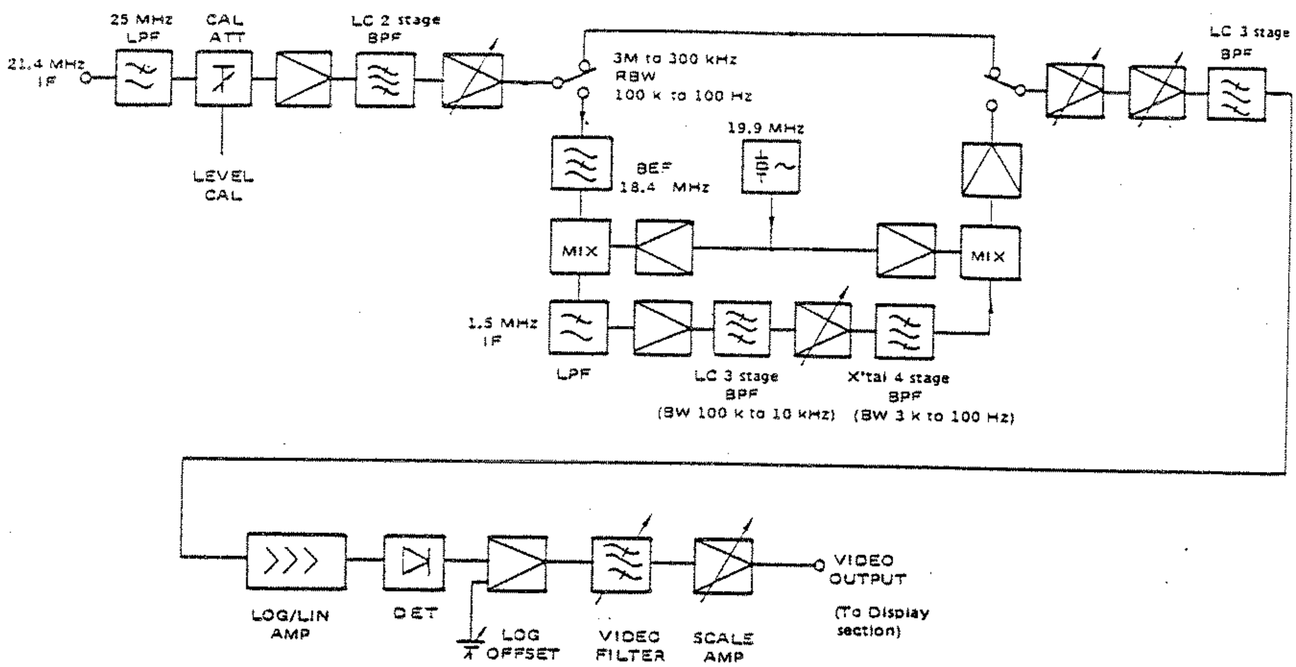



Fig. 6-3 IF Section Block Diagram

Processing of the 21.4 MHz IF signal is switched by the resolution bandwidth setting (≤100 kHz or 300 kHz to 3 MHz) after passing through the CAL ATT, PRE AMP, 2 stage LC BPF and step gain amplifier. If the bandwidth is between 300 kHz and 3 MHz, the IF signal is directly applied to the latter gain control amplifier and a 3-stage LC BPF circuit.

If the bandwidth is 100 kHz or below, the IF signal is converted to a 1.5 MHz IF signal by a mixer. The bandwidth is then determined by a 3-stage LC BPF (100 kHz to 10 kHz) and a 4-stage crystal BPF (3 kHz to 100 Hz).

The signal, after passing through the 1.5 MHz IF circuit, is reconverted to a 21.4 MHz signal by a mixer and is applied to the 21.4 MHz amplifiers and BPF circuit.

After passing a LOG/LIN amplifier, the IF signal is applied to an envelope detector. The detected signal or a VIDEO signal is sent to the Display section through an offset control, a video filter and a scale amplifier circuit.

## 6.4 DISPLAY and CONTROL Sections

The block diagram of the display and control sections is shown in Fig. 6-4.

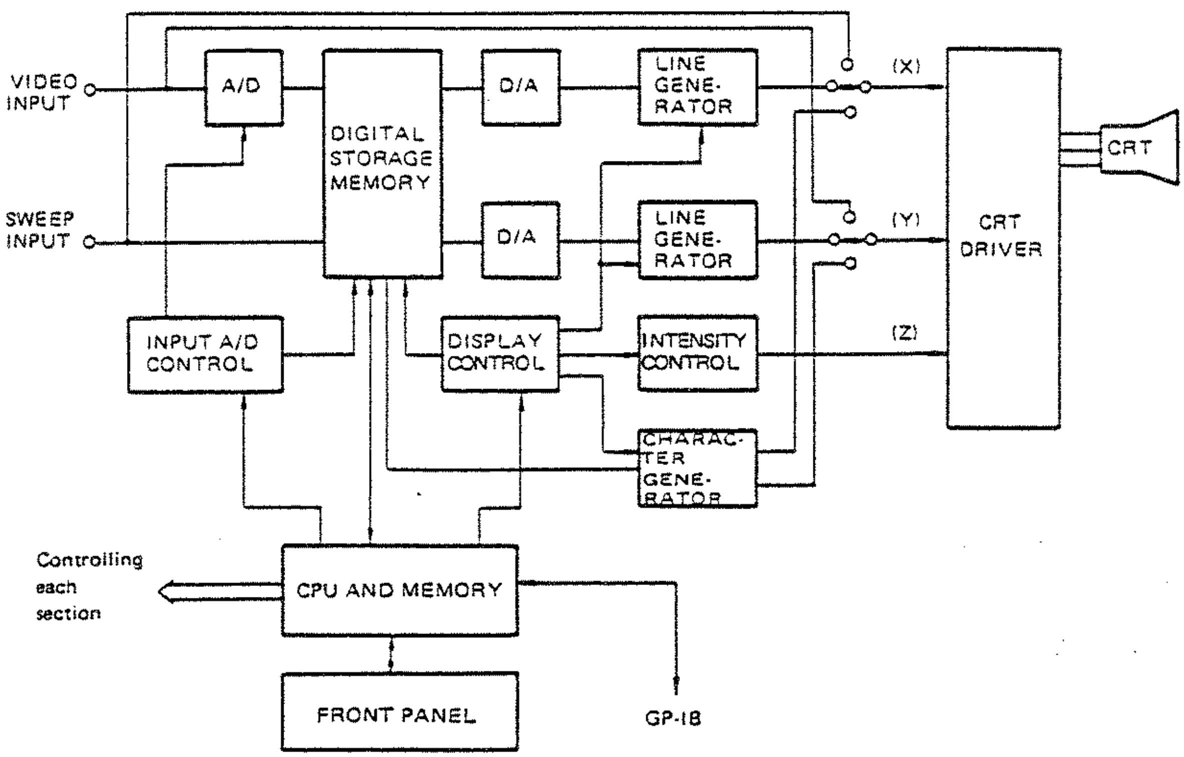



Fig. 6-4 Display and Control Section Block Diagram

The VIDEO signal from the IF section is A/D converte and stored in the digital storage memory (excluding FAST SWEEP in time domain, 2 μs/div to 1 ms/div). For display to the screen, the data from the memory are read and subjected to D/A conversion (independent refresh cycles for spectrum data and graticule) and fed to the CRT DRIVE circuit through the line generator. The CHARACTER GENERATOR circuit is used to display characters.

Control signals from the front panel are routed to the CPU AND MEMORY section and used to set the hardware sections. The control signals are also used to control the digital storage functions.

SECTION 7

# PERIODIC CALIBRATION AND DAILY MAINTENANCE

## 7.1 CAL OUTPUT Signal Calibration

The CAL OUTPUT signal, as explained in paragraph 3.6, ensures the measurement accuracy of the MS710[ ]. It is derived from a highly stable crystal oscillator designed to output a constant frequency over a long period of time. However, as a precaution, it is recommended that the check explained below, is made about every six months to confirm that the correct signal is being output.

Required measuring instruments are:

| | |
|---|---|
| Power Meter | Anritsu ML83A |
| Power Sensor | Anritsu MA72A |
| Frequency Counter | Anritsu MF57A |
| Coaxial Adapter | N(J)-BNC(P) |
| Coaxial Adapter | N(J)-N(J) |

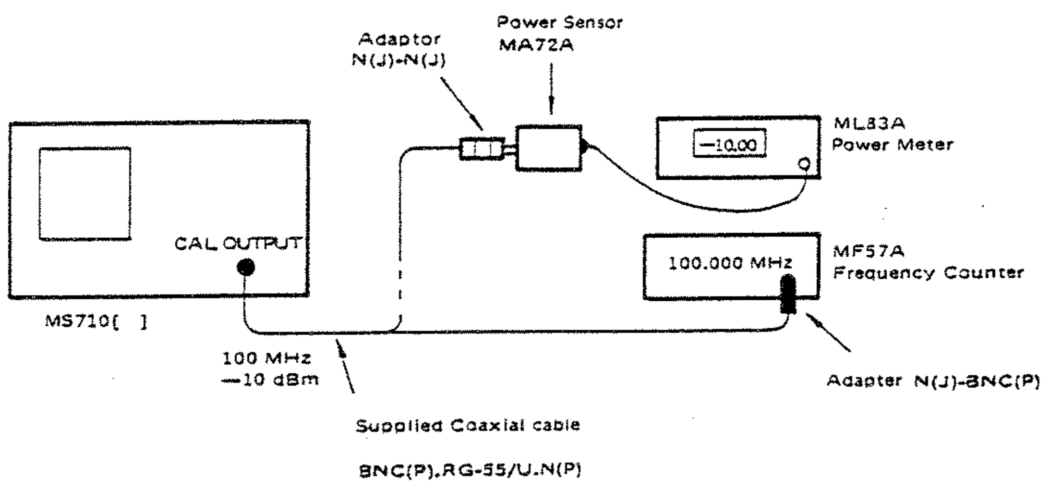



Fig. 7-1 CAL OUTPUT Signal Calibration Setup

Connect the CAL OUTPUT signal to the frequency counter and the power meter as shown in Fig. 7-1, with the supplied coaxial cable and required adaptors. Confirm that the signal is within the following values:

Frequency: 100 MHz ±3 kHz
Level: -10 dBm ±0.3 dBm

If the counter and meter values are not within the above values, other parts of the MS710[ ] may not operate normally. Refer to the service manual and perform a more detailed check.

## 7.2 General Maintenance

General maintenance usually means cleaning and visual inspection on a regular basis. This will help to improve the reliability of the instrument. General maintenance procedures are shown in Table 7-1.

Table 7-1 General Maintenance

| Problem | Occurrence | Procedure |
|---|---|---|
| Dirt | ° Prior to storage for extended period of time | Clean with industrial cleaning solvent. |
| Dust, etc. | ° When used in dusty environment | Blow-out with compressed air. |
| Loose knobs, screws | When found | Retighten |

## 7.3 Storage

### 7.3.1 Notes

When storing the MS710[ ] for long periods of time, do not store it in:

1 places subject to extreme temperatures (below -25°C or over 55°C) and humidity (over 90%)

2 places subject to direct sunlight

3 dusty, dirty places

4 places exposed to active gases or where condensation occurs because this will cause corrosion.

The MS710[ ] should be cleaned prior to storage.

### 7.3.2 Recommended storage conditions

In addition to satisfying the above requirements, the following storage conditions are also recommended:

Temperature; 0° to 30°C and humidity; 40% to 80% (places where temperature and humidity do tno fluctuate appreciably).

SECTION 8

PERFORMANCE CHECK

## 8.1 Introduction

This section describes the methods for testing the performances in the specifications of Section 2.

If the MS710[ ] passes all the performance tests described in this section, it is operating normally. If any items do not satisfy the specifications, repair and adjust according to the Service Manual.

Table 8-1 Performance Check Item List

| Check Item No. | Check Contents |
|---|---|
| 1 | CAL OUTPUT |
| 2 | Center Frequency Readout Accuracy |
| 3 | Frequency Span Readout Accuracy |
| 4 | START/STOP Frequency Readout Accuracy |
| 5 | Marker Frequency Accuracy |
| 6 | Resolution Bandwidth Accuracy |
| 7 | Resolution Bandwidth Selectivity |
| 8 | Residual FM |
| 9 | Noise Sidebands |
| 10 | Display Linearity |
| 11 | Screen Display (Log Scale) Switching Error |
| 12 | Reference Level Accuracy |
| 13 | Reference Level Frequency Response |
| 14 | Input Attenuator Accuracy |
| 15 | 2nd Harmonic Distortion |
| 16 | Two Signal 3rd Order Intermodulation Distortion |
| 17 | Residual Response |
| 18 | Average Noise Level |

## 8.2 Equipment Required for Performance Checks

The equipment required to make the performance checks described in this section are listed in Table 8-2.

Table 8-2 Equipment Required for Performance Checks

| Equipment | Required Performance | Application (Item No.) |
|---|---|---|
| Power Meters and Sensors: | Measurement range: −30 to +20 dBm | 1, 7 |
| | Frequency: 10 kHz to 1000 MHz | 7 |
| | Frequency: 10 MHz to 18 GHz | 1, 7, 14, 16 |
| | Frequency: 18 GHz to 23 GHz | 7 |
| Frequency Counter MF76A | Frequency: 100 kHz to 18 GHz | 1 to 6, 15, 16 |
| | Frequency: 18 GHz to 23 GHz | 2 to 4, 15 |
| Signal Source MG655A (Synthesized Signal Generator) | Frequency: 100 kHz to 1300 MHz | 2, 5, 7, 10, 12, 13, 15, 16 |
| | Frequency: 1 GHz to 23 GHz | 2 to 5, 8, 13, 16 |
| Resistance Attenuator MN510C | 0 to 80 dB, 0.1 dB step, 100 MHz, 50 Ω | 2 to 4, 10, 12 |
| | 0 to 75 dB, 5 dB step, 6.5 GHz, 50 Ω | 9, 14 |
| Signal Generator MG724A1 to D1 | Frequency: 100 kHz to 6.5 GHz | 8, 9 |
| | Frequency: 1.7 GHz to 7.2 GHz | |
| Connector Adapter | N(J) − N(J) | 1 |
| Power Divider | Frequency: 100 kHz to 23 GHz | 2 to 4, 16 |
| Termination MP752A | Impedance: 50 Ω | 10, 11 |
| | Frequency: 5 GHz to 12.4 GHz | |

Table 8-2 (Continued)

| Equipment | Required Performance | Application (Item No.) |
|---|---|---|
| T-PAD (Two signal characteristic measurement pad) | Frequency: 10 to 1000 MHz | 16 |
| Isolator | Frequency: 7 GHz, 12.5 GHz | 16 |
| LPF | Frequency(fc): 5 MHz, 10 MHz, 100 MHz, 500 MHz, 980 MHz, 8 GHz | 15 |
| | 15 MHz, 1000 MHz, 7 GHz | 16 |
| | Effective attenuation: ≧50 dB (at 2xfc) | |

## 8.3 Preliminary Operations

### 8.3.1 Test Conditions

The environmental conditions under which the specifications of the MS710[ ] are guaranteed are an ambient temperature of 0° to 50°C and relative humidity 95% or less. Complete the performance checks within these ranges.

### 8.3.2 Preparations

Before performing other tests, the Cal Output test described in item 1 of paragraph 8.4 must be made, and the MS710[ ] self-calibration (see paragraph 3.5) must be performed using the calibration output shown in paragraph 8.4.

In performance test procedures in paragraph 8.4, unless otherwise specified, set the COUPLED FUNCTION (RES BW, VIDEO BW, SWEEP TIME, and INPUT ATTEN) to AUTO. Set the other settings (REFERENCE LEVEL, SCALE, DISPLAY, etc.) to the initial value which is automatically selected when the selection switch of each frequency band (10 kHz to 30 MHz, 100 kHz to 2 GHz, 1.7 to 23 GHz) is pressed.

Note:

The detailed descriptions of measuring procedures are shown for only a part of the total performance check. However, to fill in the attached data sheets the remainder are easily carried out in similar ways with slightly different conditions such as different center frequency.

## 8.4 Performance Check Procedure

### 1. CAL OUTPUT

Specifications:

| | |
|---|---|
| Output level | -10 dBm ±0.3 dB |
| Frequency | 100 MHz ±3 kHz |

Data Sheet: Table 8-3

Configuration

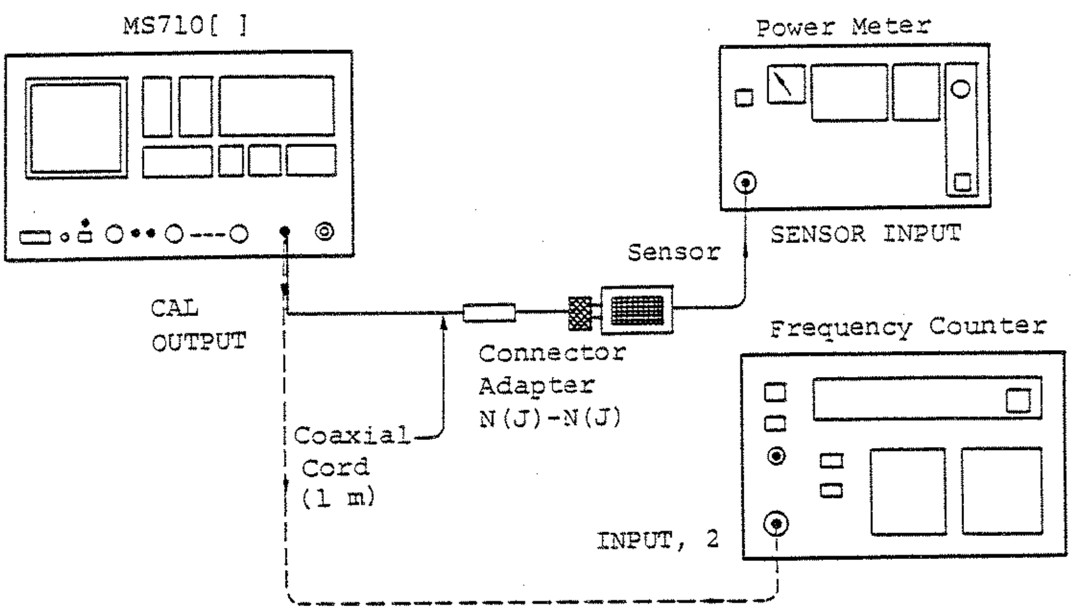



Fig. 8-1 CAL OUTPUT Test Setup

Procedure

| Step | Procedure |
|---|---|
| 1 | After Power Meter zero adjustment and self-calibratio connect the Sensor to the MS710[ ] CAL OUTPUT with an Adapter and the accessory coaxial cord as shown in Fi 8-1, and read the output level. |
| 2 | Connect the CAL OUTPUT signal with the frequency counter as shown in Fig. 8-1 and read the output frequency. |

2. Center Frequency Readout Accuracy

Specifications

± (The following accuracy E + 20% of frequency span/DIV + 10% of resolution bandwidth)

E = 30 kHz x N (MS710C/E)
1 MHz x N (MS710D/F)

E = 3 kHz (10 kHz to 30 MHz Band only)

N: Harmonic mixing mode order number

Data Sheet: Table 8-4

Configuration

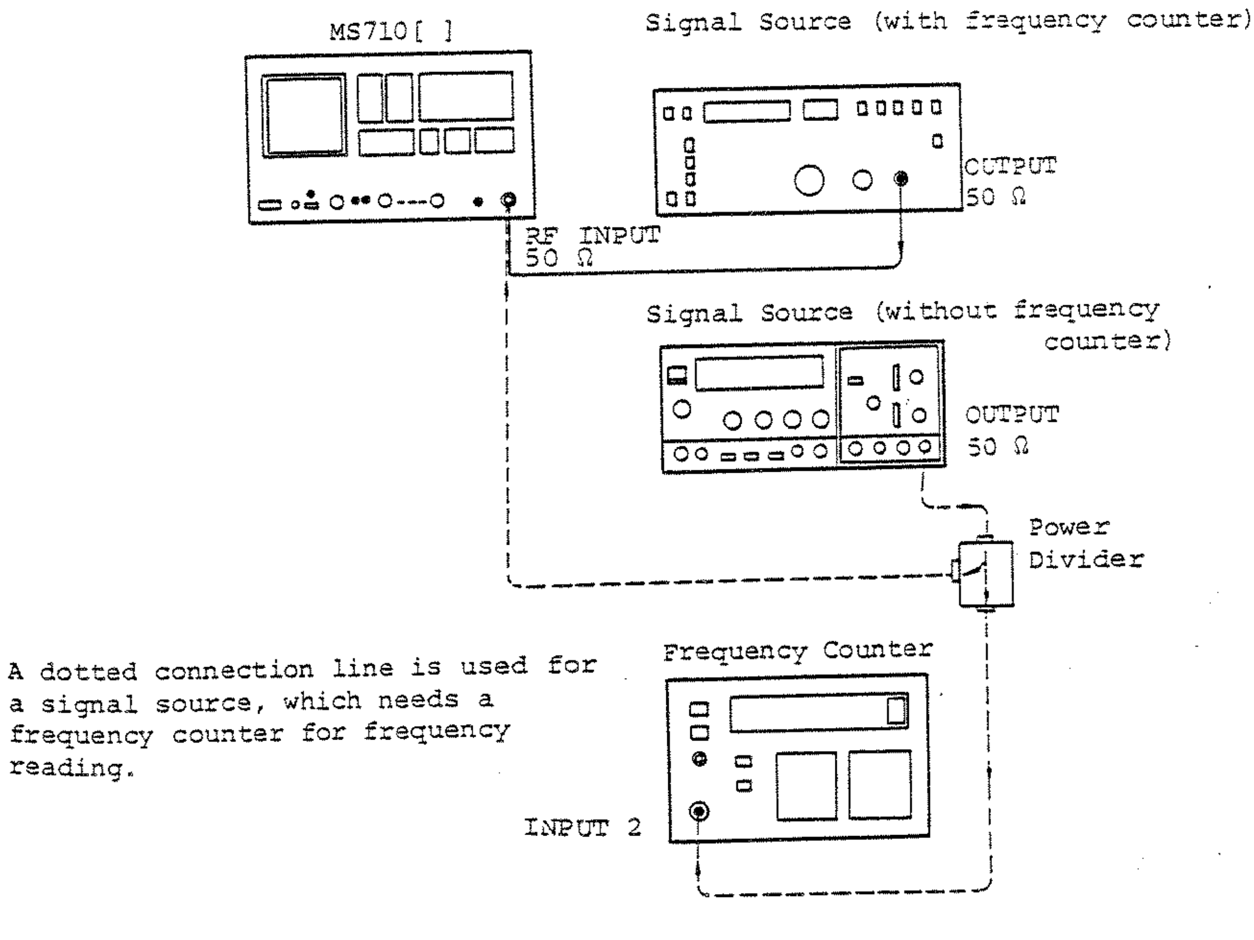



Fig. 8-2 Center Frequency Readout Accuracy, Frequency Span Readout Accuracy, and Start/Stop Frequency Readout Accuracy Tests Setup

Procedure-1 (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 1000.0 MHz<br>FREQ SPAN/DIV ................ 200 MHz/div |
| 2 | Set the Signal Source output as follows:<br>FREQUENCY (CW) ............... approx. 1000 MHz<br>LEVEL ........................ 0 dBm |
| 3 | Fine-adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen. Read the signal source frequency as the actual measured value. |
| 4 | Change frequency span to 100 kHz/ and fine-adjust the Signal Source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |
| 5 | Change the center frequency of the MS710[ ] and the output frequency of the Signal Source to 10 MHz and fine-adjust the Signal Source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |

CAUTION

Use the number/unit key to set the Center Frequency to be tested. Do not use the "PEAK → CRT" key to locate the signal spectrum trace at the center position of the CRT display.

(Continued)

| Step | Procedure |
|---|---|
| 6 | Set center frequency of the MS710[ ] and the output frequency of the signal source to 2 GHz and fine adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |

Procedure-2 (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ........................ 1.7 to 23 GHz<br>CENTER FREQ ...................... 1.700 GHz<br>FREQ SPAN/DIV .................... 100 kHz/div |
| 2 | Set the signal source output as follows:<br>RF FREQUENCY ..................... approx. 1.7 GHz<br>LEVEL ............................ 0 dBm |
| 3 | Fine-adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |
| 4 | Change the signal source frequency to approximately 6.5 GHz. |
| 5 | Set the center frequency of the MS710[ ] to 6.5 GHz and adjust the signal source frequency so that the peak of the spectrum is at the center of the screen; read the signal source frequency. |

(Continued)

| Step | Procedure |
|---|---|
| 6 | Change the signal source frequency to approximately 12.5 GHz. |
| 7 | Set the center frequency to 12.5 GHz and the frequency span to 1 MHz/div. Fine-adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |
| 8 | Change the signal source frequency to approximately 18 GHz. |
| 9 | Set the center frequency of the MS710[ ] to 18 GHz. Fine adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |
| 10 | Change the signal source frequency to approximately 23 GHz. |
| 11 | Set the center frequency of the MS710[ ] to 23 GHz. Fine-adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency.<br>In addition to the measurement procedures described in step 1 and step 2 above, test for the frequencies and spans required by the user. |

Procedure-3 (10 kHz to 30 MHz band) (MS710C only)

| Step | Procedure |
|---|---|
| 1 | Set the MS710C as follows:<br>FREQ BAND .................... 10 kHz to 30 MHz<br>CENTER FREQ .................. 15 MHz<br>FREQ SPAN/DIV ................ 3 MHz/div |
| 2 | Set the Signal Source output as follows:<br>FREQUENCY (CW) ............... approx. 15 MHz<br>LEVEL ........................ 0 dBm |
| 3 | Fine-adjust the signal source frequency so that the peak of the spectrum trace is at the center of the screen. Read the signal source frequency as the actual measured value. |
| 4 | Change frequency span to 10 kHz/ and fine-adjust the Signal Source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |
| 5 | Change the center frequency of the MS710C and the output frequency of the Signal Source to 100 kHz and fine-adjust the Signal Source frequency so that the peak of the spectrum trace is at the center of the screen; read the frequency. |

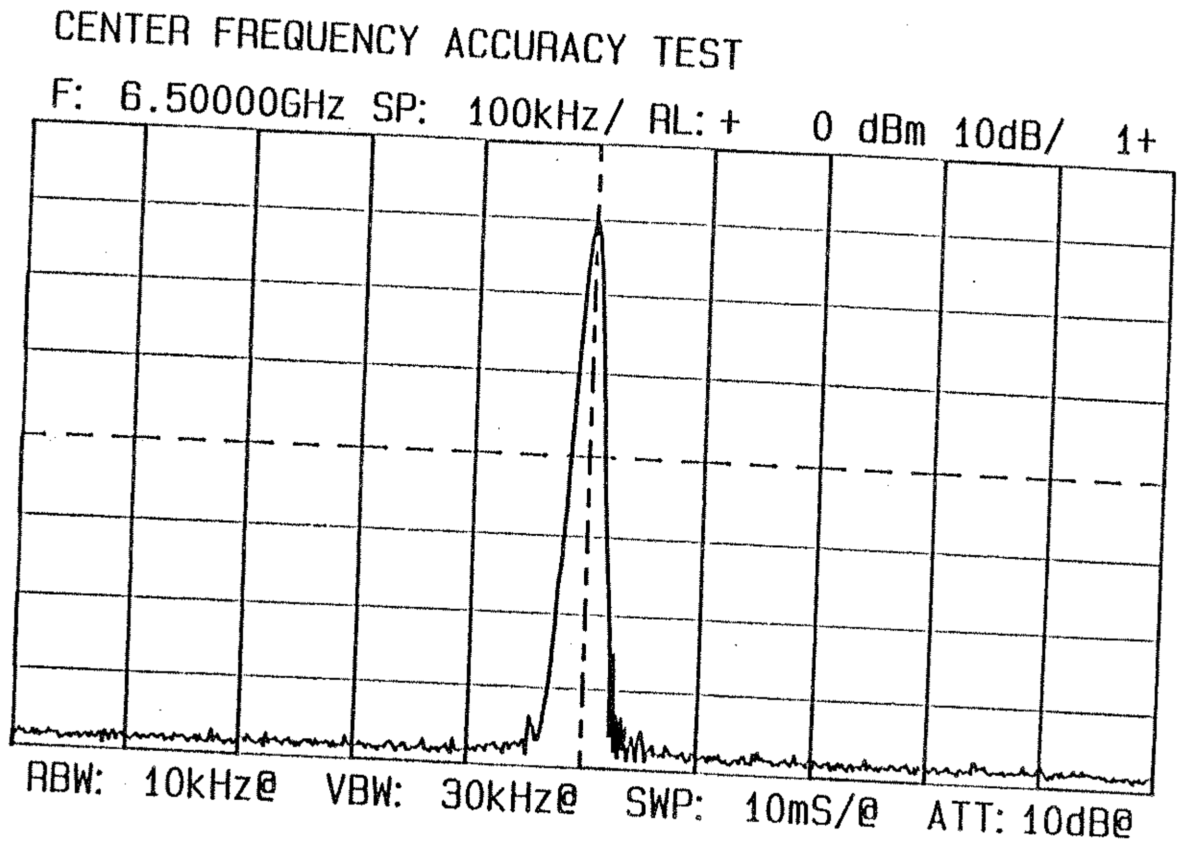



Fig. 8-3 Center Frequency Readout Accuracy Test Sample CRT Display

3. Frequency Span Readout Accuracy

Specifications

± 5% (200 MHz/div - 6 kHz/div)

±10% (5 kHz/div - 1 kHz/div)

Data Sheet: Table 8-5

Configuration

Same as Fig. 8-2.

Procedure (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ........................ 1.7 to 23 GHz<br>CENTER FREQ ...................... 3 GHz<br>FREQ SPAN/DIV .................... 200 MHz/div<br>* Other frequencies can also be selected to match the frequency of the signal source. |
| 2 | Set the signal source output as follows:<br>RF FREQUENCY .................... approx. 3 GHz<br>LEVEL ........................... 0 dBm |
| 3 | Adjust the signal source frequency so that the peak of the spectrum trace is at the vertical scale at the left end of the screen; read the frequency, fL. |
| 4 | Change the signal source frequency and set the peak of the spectrum trace to the Nth vertical scale (N=1 to 10, Fig. 8-4 is for N=7) from the left; read the frequency, fR. |

(Continued)

| Step | Procedure |
|---|---|
| 5 | Calculate the frequency span per division from (fR - fL)/N and check that it is within the specifications.<br>In example Fig. 8-4,<br>(3420 - 1987)/7 = 204.7 MHz/div<br>Therefore, the error is +2.35% (204.7/200 = 1.0235). |
| 6 | Set the frequency span to another value other than 200 MHz/div and re-test as described in steps 3 to 5. |

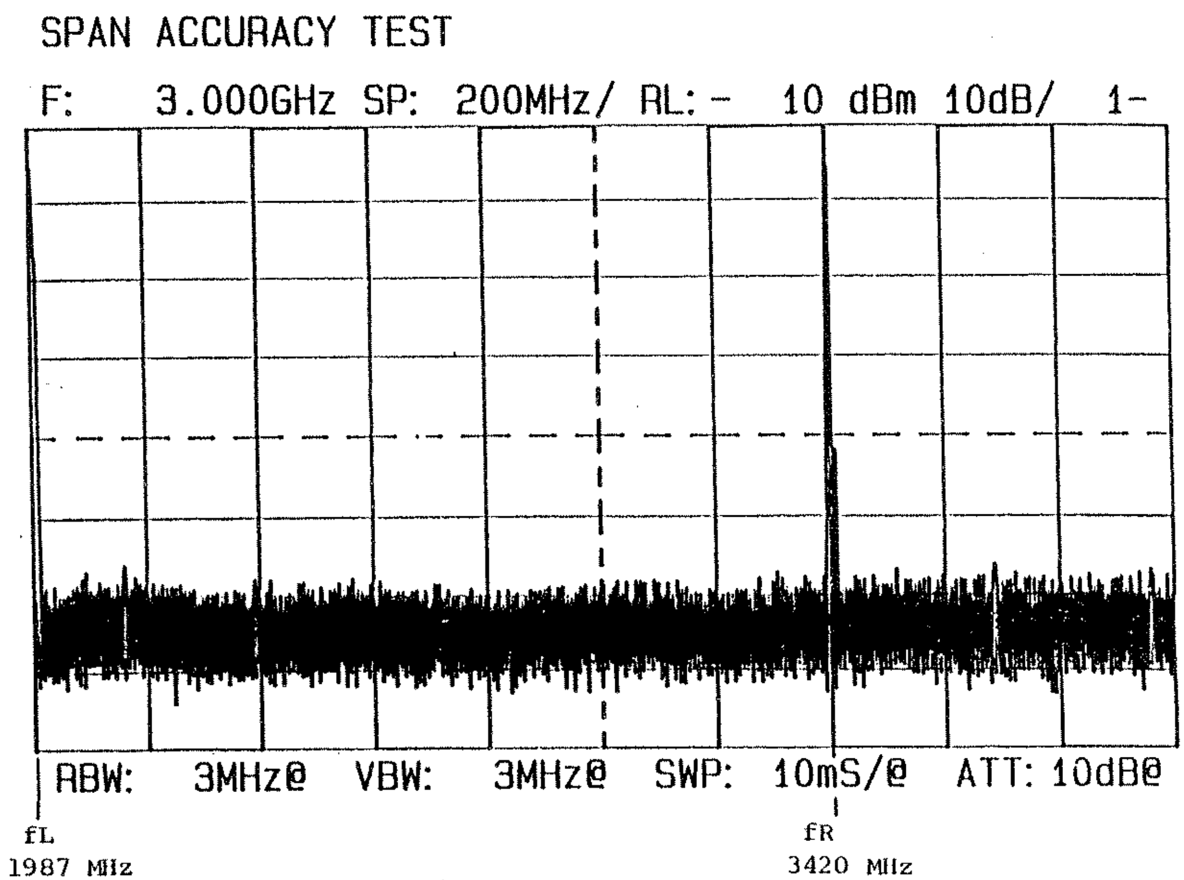



Fig. 8-4 Frequency Span Readout Accuracy Test Sample CRT Display

4. START/STOP Frequency Readout Accuracy

Specifications

± (center frequency accuracy + 2.5% of span*)

*: Span = STOP frequency - START frequency

Data Sheet: Table 8-6

Configuration

Same as Fig. 8-2.

Procedure (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Press the FREQ BAND 1.7 to 23 GHz switch and set:<br>START ........................ 1.700 GHz<br>STOP ......................... 23.000 GHz |
| 2 | Set the signal source output as follows:<br>FREQUENCY ................... approx. 1.7 GHz<br>LEVEL ........................ 0 dBm |
| 3 | Fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the left of the screen; read the frequency (START frequency). |
| 4 | Change the signal source frequency to approximately 23 GHz and fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the right of the screen; read the frequency (STOP frequency). |

(Continued)

| Step | Procedure |
|---|---|
| 5 | Set the MS710[ ] as follows:<br>START ......................... 2.000 GHz<br>STOP .......................... 12.000 GHz |
| 6 | Change the signal source frequency to approximately 2 GHz, and fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the left of the screen; read the frequency (START frequency). |
| 7 | Change the signal source frequency to approximately 12 GHz, and fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the right of the screen; read the frequency (STOP frequency). |
| 8 | Set the MS710[ ] as follows:<br>START ......................... 2.000 GHz<br>STOP .......................... 5.000 GHz |
| 9 | Change the signal source frequency to approximately 2 GHz, and fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the left of the screen; read the frequency (START frequency). |

(Continued)

| Step | Procedure |
|---|---|
| 10 | Change the signal source frequency to approximately 5 GHz, and fine-adjust the signal source frequency so that the peak of the spectrum trace is on the vertical scale at the right of the screen; read the frequency (STOP frequency). |

Note:

Check the setting of the other START/STOP frequencies required by the user in the same manner as above. This performance test is not necessary, when the frequency span test of item 3 is OK and the STOP/START frequency is less than 2000 MHz, because the START/STOP frequency mode operation is done by the center frequency-frequency span mode operation in the MS710[ ] hardware.

5. Marker Frequency Accuracy

Specifications

± (20% of Span/div + 10% of RES BW + E)

| | | |
|---|---|---|
| E = 3 kHz | for 10 kHz to 30 MHz Band | (MS710C/E) |
| E = 26 kHz + CF x 0.000005 | for 100 kHz to 2 GHz Band | |
| E = CF x 0.00001 | for CF ≧1.7 GHz | |

E = 1 MHz x N (N: Harmonic mixing mode order number) (MS710D/F)

Data Sheet: Table 8-7

Configuration

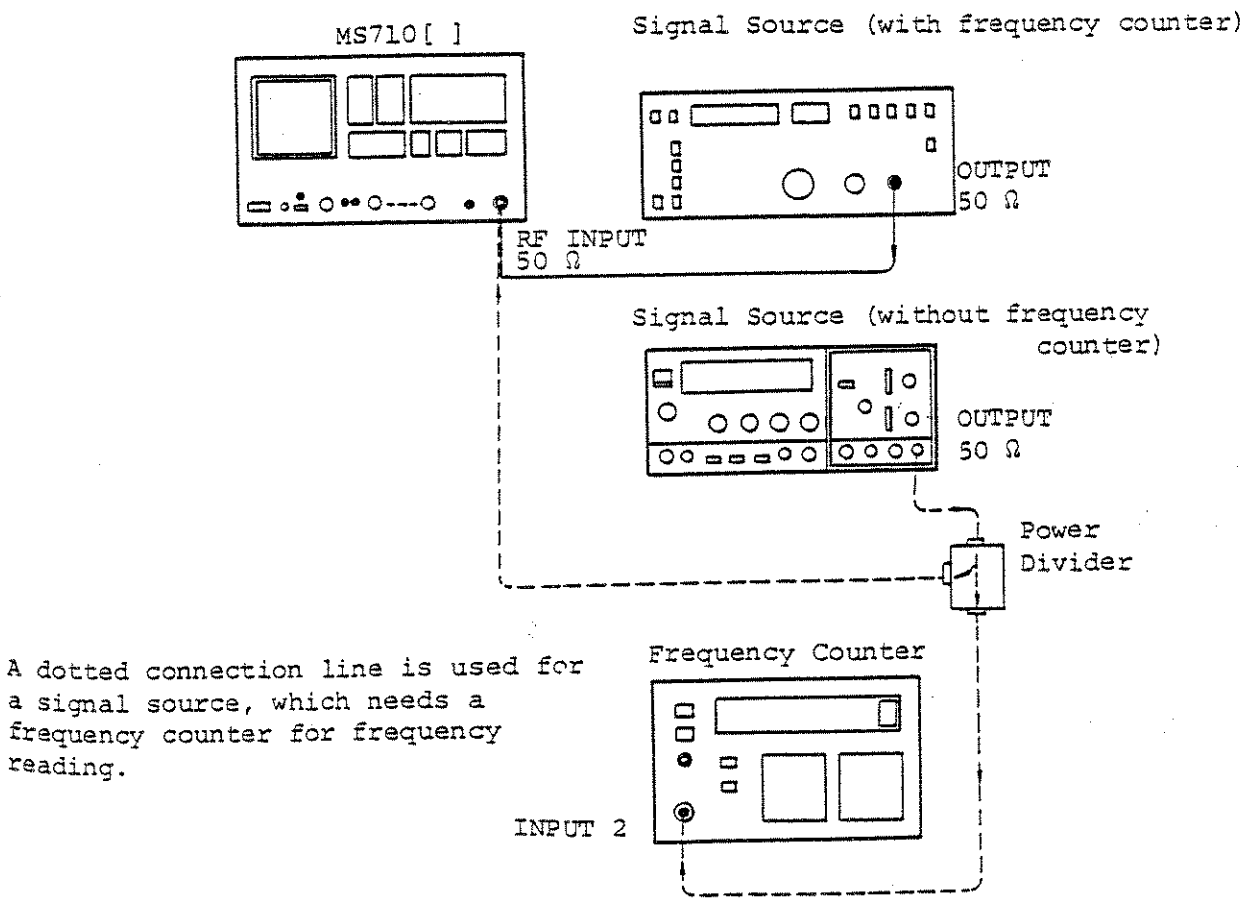



Fig. 8-5 Marker Frequency Accuracy Setup

Procedure-1 (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ ................. 1000.0 MHz<br>FREQ SPAN/DIV ............... 100 kHz/div |
| 2 | Set the signal source as follows:<br>FREQUENCY (CW) (=fs) ........ 1000.0 MHz<br>LEVEL ....................... 0 dBm |
| 3 | Read the frequency ($f_M$) at the peak level of the input signal with the MS710[ ] NORMAL marker. Then, obtain the marker frequency accuracy from the following equation:<br>Marker frequency accuracy = $f_M - f_S$ |
| 4 | Change the MS710[ ] FREQ SPAN/DIV to 200 MHz/div, and measure the marker frequency accuracy using the same procedure as in Step 3. |

Procedure-2 (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................. 1.7 to 23 GHz<br>CENTER FREQ ................. 1.700 GHz<br>FREQ SPAN/DIV ............... 100 kHz/div |
| 2 | Set the signal source as follows:<br>FREQUENCY (CW) (=fs) ........ 1.700 GHz<br>LEVEL ........................ 0 dBm |
| 3 | Read the frequency ($f_M$) at the peak level of the input signal with the MS710[ ] NORMAL marker. Then, obtain the marker frequency accuracy from the following equation:<br>Marker frequency accuracy = $f_M - f_S$ |
| 4 | Change the MS710[ ] FREQ SPAN/DIV to 200 MHz/div, and measure the marker frequency accuracy using the same procedure as in Step 3. |

Procedure-3 (10 kHz to 30 MHz band) (MS710C only)

| Step | Procedure |
|---|---|
| 1 | Set the MS710C as follows:<br>FREQ BAND .................... 10 kHz to 30 MHz<br>CENTER FREQ .................. 15.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div |
| 2 | Set the signal source as follows:<br>FREQUENCY (CW) (=fs) ........ 15.0 MHz<br>LEVEL ........................ 0 dBm |
| 3 | Read the frequency ($f_M$) at the peak level of the input signal with the MS710C NORMAL marker. Then, obtain the marker frequency accuracy from the following equation:<br>Marker frequency accuracy = $f_M - f_S$ |
| 4 | Change the MS710C FREQ SPAN/DIV to 200 MHz/div, and measure the marker frequency accuracy using the same procedure as in Step 3. |

6. Resolution Bandwidth Accuracy

Specifications

±20%, 100 Hz to 3 MHz bandwidth at -6 dB points

Data Sheet: Table 8-8

Configuration

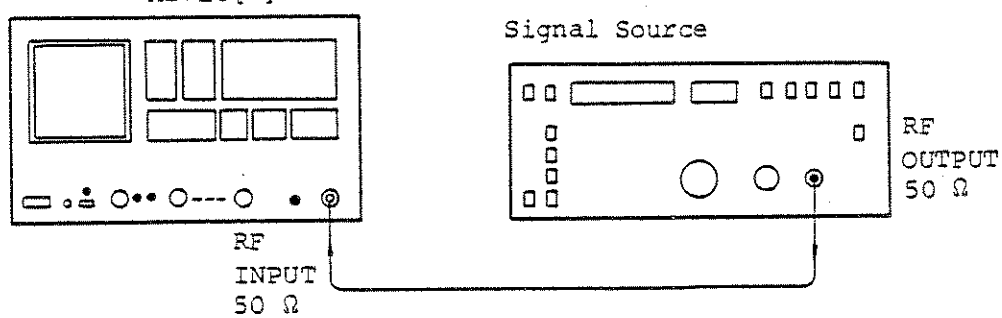



Fig. 8-6 Resolution Bandwidth Accuracy Test Setup

Procedure

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 100 MHz<br>FREQ SPAN/DIV ................ 1 MHz/DIV<br>RES BW ....................... 3 MHz<br>REFERENCE LEVEL .............. 0 dBm<br>VERTICAL SCALE ............... LOG 1 dB/div |

(Continued)

| Step | Procedure |
|---|---|
| 2 | Set the signal source as follows:<br>FREQUENCY .................. 100 MHz<br>LEVEL ...................... 0 dBm |
| 3 | Fine-adjust the signal source level so that the maximum level of the CAL signal spectrum coincides with the top horizontal scale line (reference level line) on the screen. |
| 4 | Lower the FREQ SPAN/DIV to 0 Hz while fine-adjusting the MS710[ ] center frequency so that the maximum value of the spectrum coincides with the top horizontal scale line. |
| 5 | Change the signal source frequency so that the spectrum trace coincides with the line 6 dB below the top horizontal scale line.<br>Obtain the resolution bandwidth from the following equation where $f_L$ is the lower frequency and $f_U$ is the higher frequency.<br>RES BW = $f_U - f_L$ |
| 6 | Follow Table 8-8 and change the RES BW and SPAN/DIV, and measure the resolution bandwidth using the same procedures as in Steps 1 to 5. |

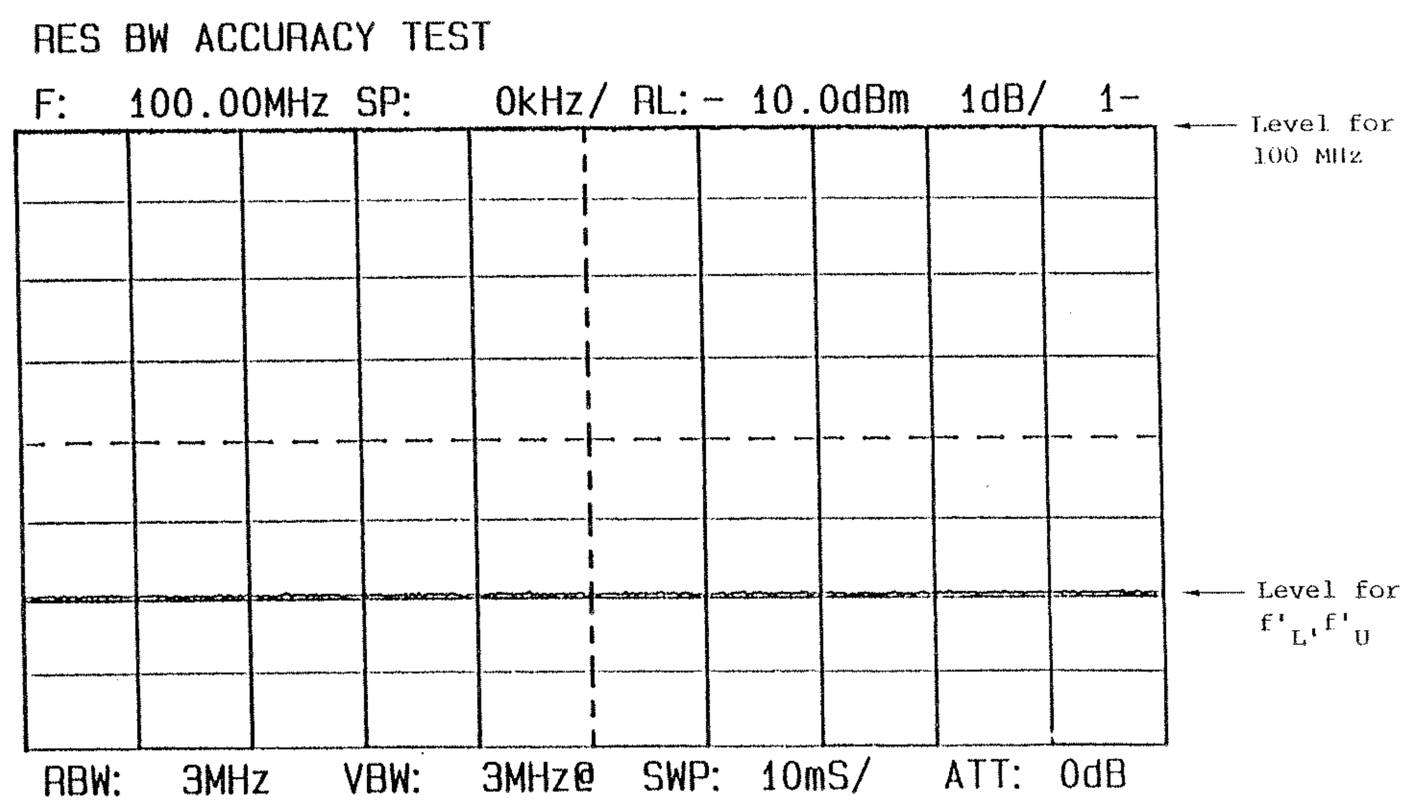



Fig. 8-7 Resolution Bandwidth Accuracy Test Sample CRT Display

7. Resolution Bandwidth Selectivity

Specifications

60 dB/6 dB ratio ≤10

Data Sheet: Table 8-9

Configuration

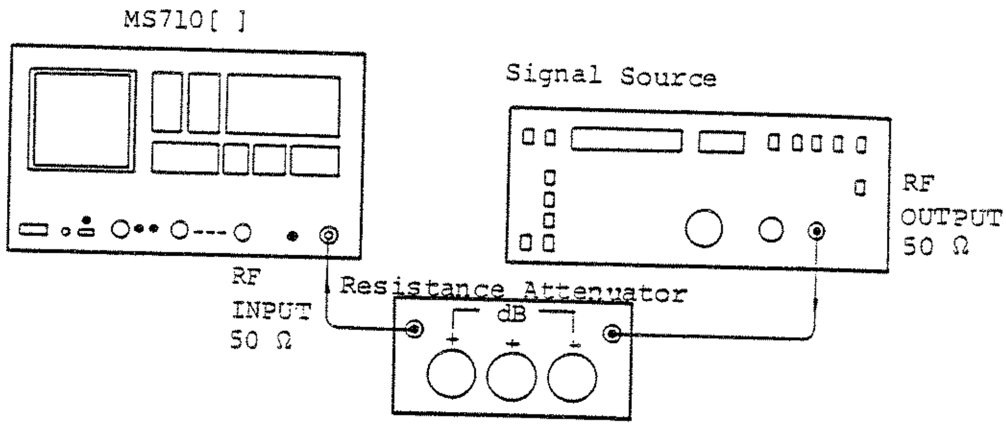


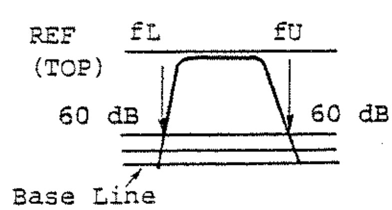

Fig. 8-8 Resolution Bandwidth Selectivity and Display Linearity Tests Setup

Procedure

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ........................ 100 kHz to 2 GHz<br>CENTER FREQ ...................... 100.0 MHz<br>FREQ SPAN/DIV .................... ZERO SPAN (0 MHz/div)<br>REFERENCE LEVEL .................. -10 dBm<br>VERTICAL SCALE ................... LOG 10 dB/div<br>VIDEO BW ......................... AUTO<br>SWEEP TIME ....................... 10 mS/div<br>INPUT ATTEN ...................... 0 dB |

(Continued)

| Step | Procedure |
| --- | --- |
| 2 | Set the resistance attenuator to 60 dB. |
| 3 | Set the signal source output as follows:<br>FREQUENCY .................. approx. 100 MHz<br>LEVEL ...................... approx. -10 dBm<br>Set the receiving level trace to maximum by fine-adjusting the signal source frequency. |
| 4 | Fine-adjust the signal source level so that the receiving level trace coincides with the second horizontal scale line above the baseline. |
| 5 | Set the resistance attenuator to 0 dB and check that the trace of the receiving level reaches the top horizontal scale line (REFERENCE LEVEL). |
| 6 | Lower the signal source frequency and read the signal source frequency (fL) at the point at which the receiving level trace has dropped to the second horizontal scale line above the baseline. |
| 7 | Raise the signal source frequency and read the signal source frequency (fU) at the point at which the receiving level trace has passed the maximum value and has again dropped to the second horizontal scale line above the base line. |

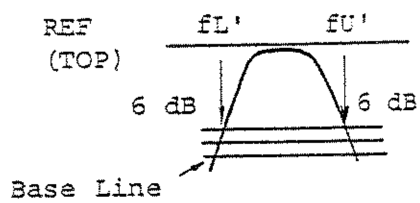


(Continued)

| Step | Procedure |
|---|---|
| 8 | Calculate the 60 dB bandwidth from (fU - fL). |
| 9 | Change the VERTICAL SCALE of the MS710[ ] to LOG 1 dB/div. |
| 10 | Set the resistance attenuator to 6 dB. |
| 11 | Set the receiving level trace to maximum by fine-adjusting the signal source frequency |
| 12 | Fine-adjust the signal source level so that the receiving level trace coincides with the second horizontal scale above the baseline. |
| 13 | Set the resistance attenuator to 0 dB (6 dB reduction) and check that the receiving level trace reaches the top horizontal scale (REFERENCE LEVEL). |
| 14 | Lower the signal source frequency and read the signal source frequency (fL') at the point at which the receiving level trace has dropped to the second horizontal scale above the baseline. |

(Continued)

| Step | Procedure |
|---|---|
| 15 | Raise the signal source frequency and read the signal source frequency (fU') at the point at which the receiving level trace has passed the maximum value and has again dropped to the second horizontal scale line above the baseline. |




| Step | Procedure |
|---|---|
| 16 | Calculate the 6 dB bandwidth from (fU' - fL'). |
| 17 | Calculate the ratio of the 60 dB bandwidth to the 6 dB bandwidth (fU - fL)/(fU' - fL'). |
| 18 | Change the RES BW 3 MHz to another value (1 MHz to 3 kHz) and re-test the RES BW as described in Steps 1 to 17. |
| 19 | If RES BW is set to 1 kHz, the 60 dB bandwidth cannot be directly measured because of the local singal noise sidebands as shown in Fig. 8-11.<br><br>Use the following procedure to determine the 60 dB bandwidth.<br><br>Find the 30 dB bandwidth when input attenuator is set to 30 dB at Step 2, and the trace of the receiving level on the 3rd horizontal scale line under the top horizontal line at Steps 4, 6, and 7. |

(Continued)

| Step | Procedure |
| --- | --- |
| | Find the 40 dB bandwidth when input attenuator is set to 40 dB at Step 2, and the trace of the receiving level on the 4th (center) horizontal scale line under the top horizontal line at Steps 4, 6, and 7.<br><br>Connect these points with a straight line, and calculate the value corresponding to the 60 dB bandwidth, as shown in Fig. 8-11.<br><br>If the 30 dB bandwidth is BW 30 dB and the 40 dB bandwidth is BW 40 dB, the equation for calculating the 60 dB bandwidth is,<br><br>60 dB bandwidth =<br>BW 40 dB + 2 (BW 40 dB - BW 30 dB) |

RES BW SELECTIVITY TEST

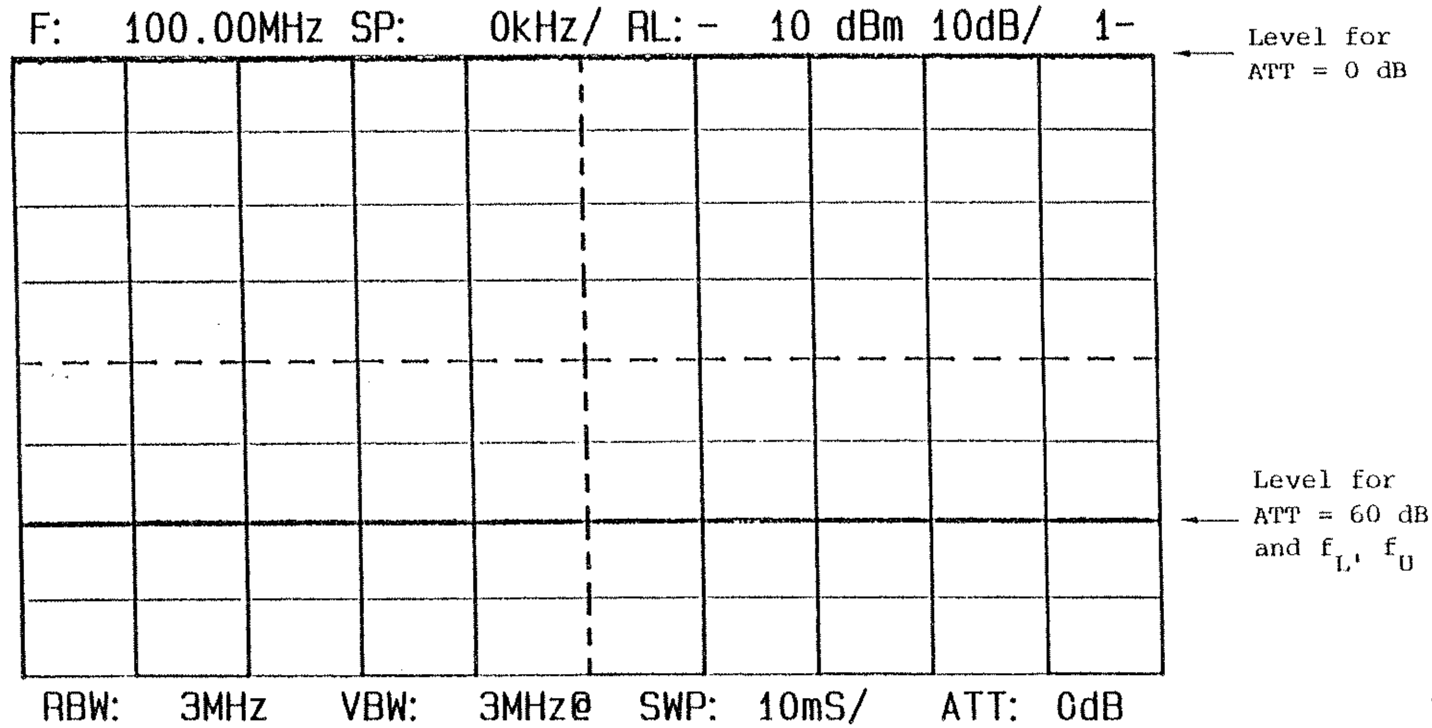



Fig. 8-9 Resolution Bandwidth Selectivity Test Sample CRT Display (1/2)

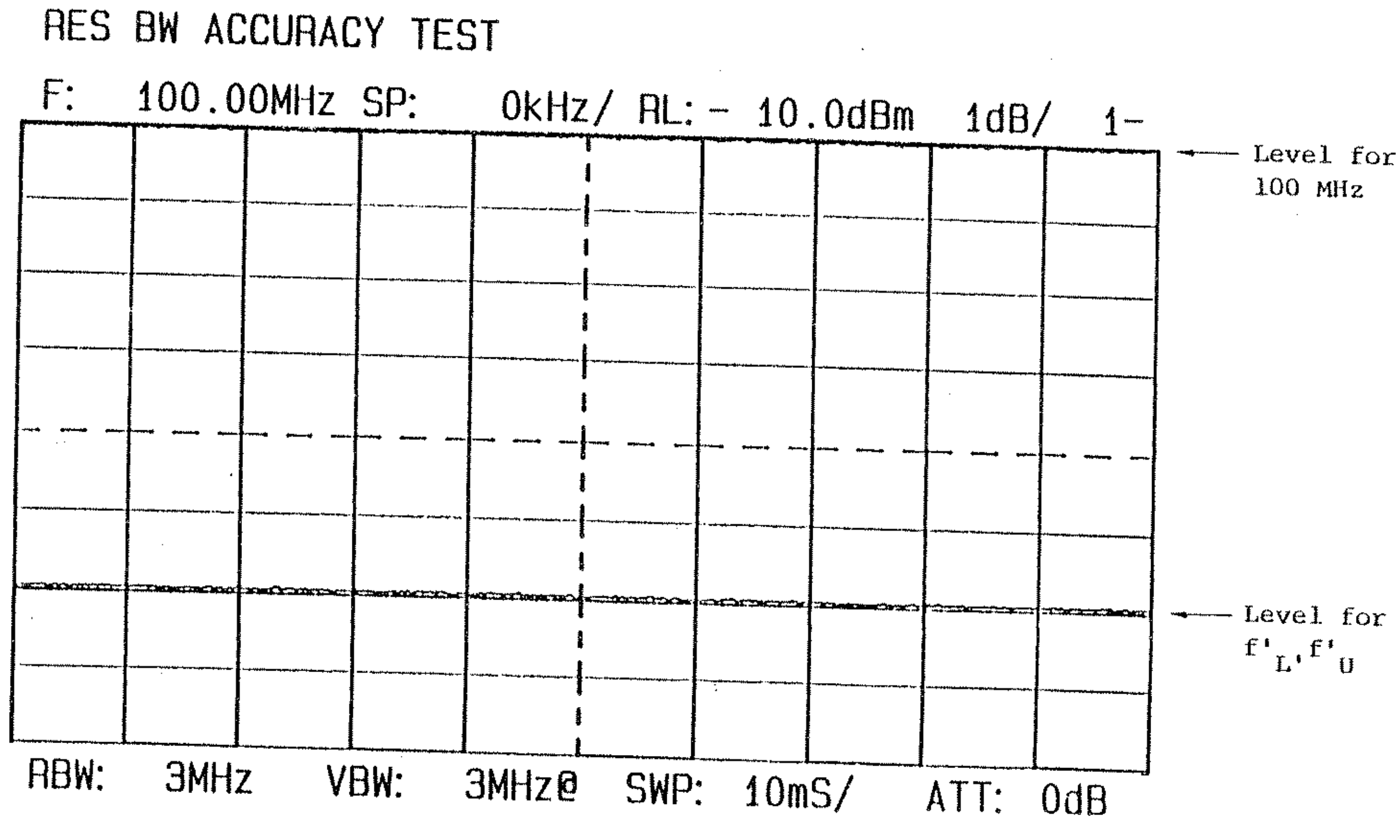



Fig. 8-10 Resolution Bandwidth Selectivity Test Sample CRT Display (2/2)

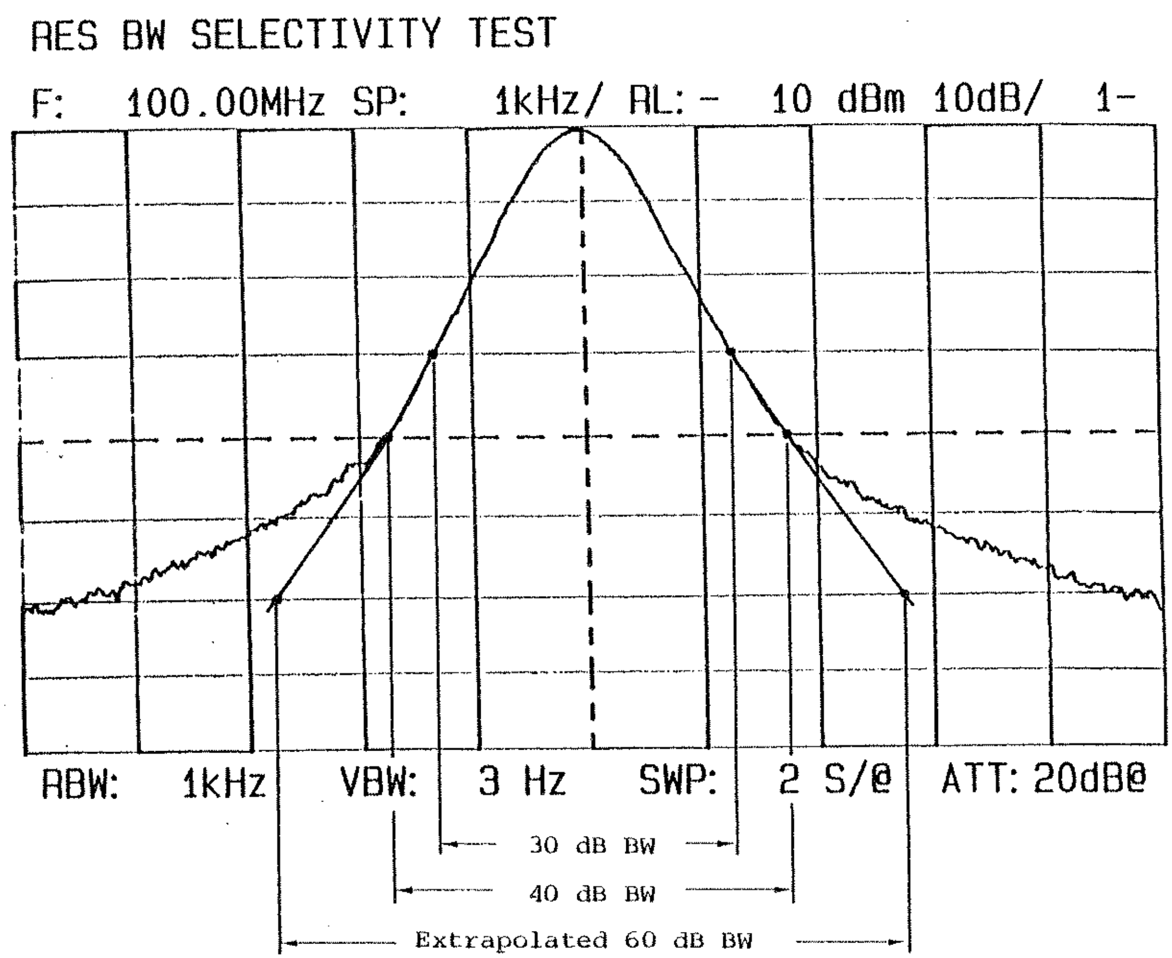



Fig. 8-11 60 dB Bandwidth of 1 kHz Resolution Bandwidth Sample Extrapolation on CRT Display

8. Residual FM

Specifications

400 Hzp-p/0.1 s or less (center frequency ≦6.5 GHz, span ≦100 kHz/div)

Data Sheet: Table 8-10

Configuration

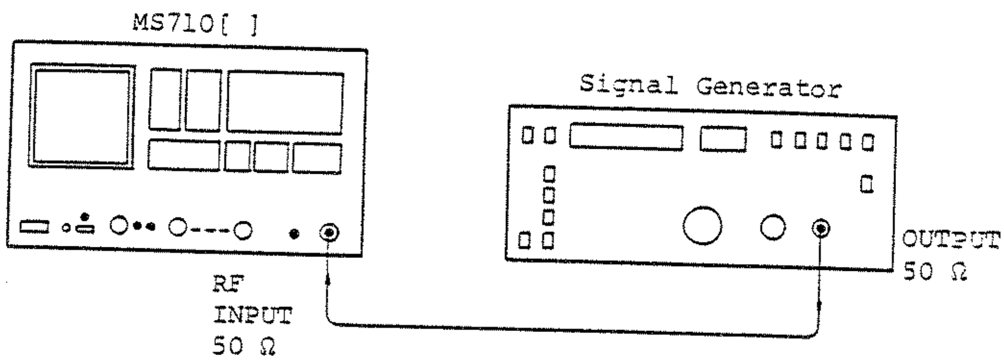



Fig. 8-12 Residual FM Test Setup

Procedure (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ...................... 1.7 to 23 GHz<br>REFERENCE LEVEL ................ 0 dBm<br>CENTER FREQ .................... 6.500 GHz<br>FREQ SPAN/DIV .................. 1 kHz/div<br>VERTICAL SCALE ................. LIN<br>AVERAGE: WRITE A ............... ON |

(Continued)

| Step | Procedure |
|---|---|
| 2 | Set the signal generator output as follows:<br>FREQUENCY .................... approx. 6.5 GHz<br>LEVEL ....................... approx. 0 dBm |
| 3 | Correlate the MS710[ ] REF LEVEL to the synthesizer output level. Fine-adjust the center frequency of the MS710[ ] so that the CRT display shown in Fig. 8-13 is obtained. |
| 4 | Set to the WRITE-off (STORE) state and find the frequency difference (F) between the points at which the horizontal axis is crossed at the second and sixth scale lines from the top as shown in Fig. 8-13 (in the example, 433 Hz). |
| 5 | Change the MS710[ ] settings to:<br>NORMAL: WRITE A ............. ON<br>FREQ SPAN/DIV ............... ZERO<br>SWEEP TIME .................. 100 ms/div<br>Fine-adjust the center frequency of the MS710[ ] so that a trace is obtained between the second and sixth scale lines from the top of the CRT as shown in Fig. 8-14. |
| 6 | Find the maximum amplitude (A) of the trace data for one horizontal axis scale line (0.1 s) as shown in Fig. 8-14 (in the example, 1.4 div). |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Calculate the residual FM from the following equation:<br>Residual FM = F x A/4 Hzp-p/0.1 s<br>In the Fig. 8-14 example, since F = 433 Hz, A = 1.4 div,<br>Residual FM = 433 x 1.4/4 = 152 Hzp-p/0.1 s |

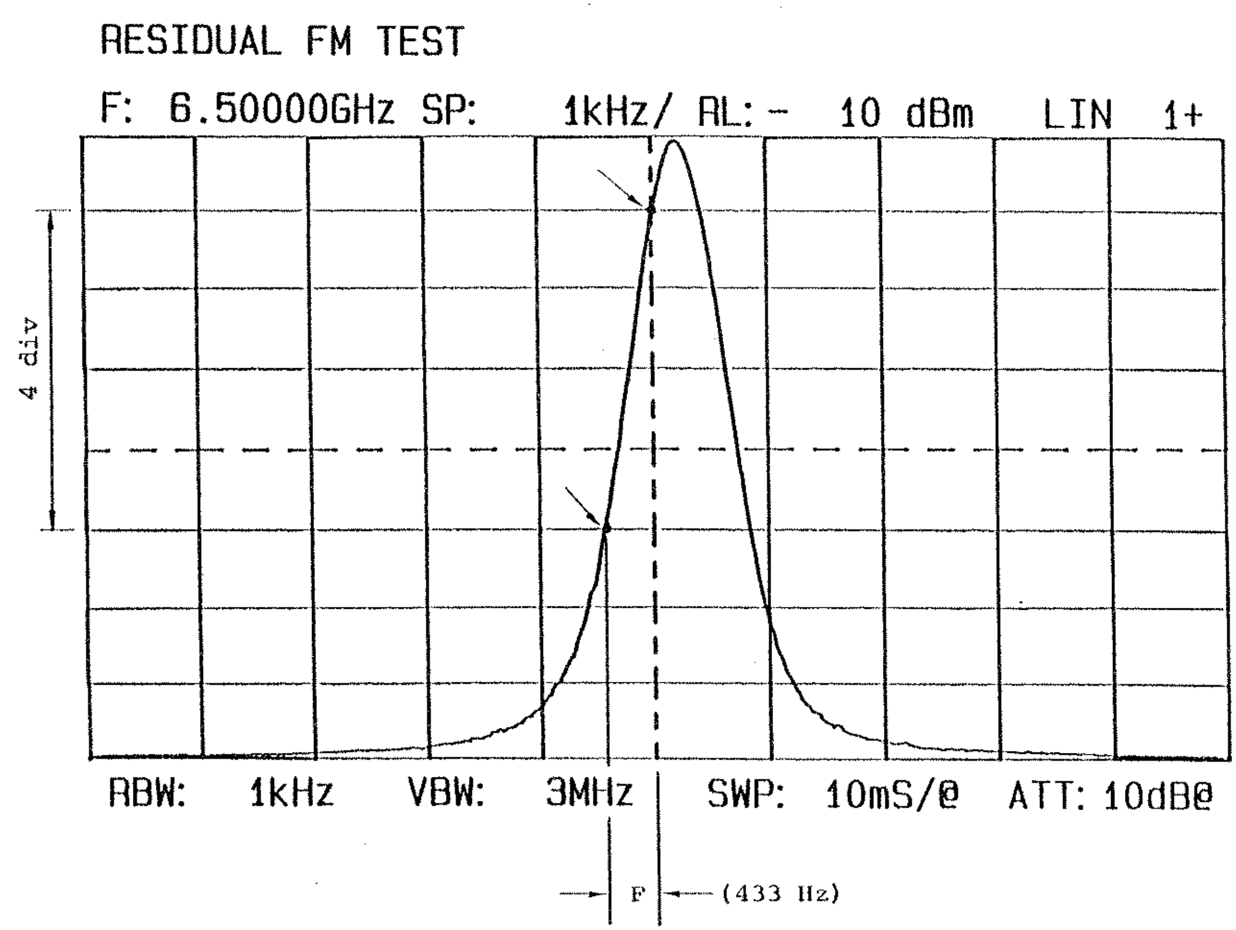



Fig. 8-13 Residual FM to AM Conversion Sensitivity Test Sample CRT Display

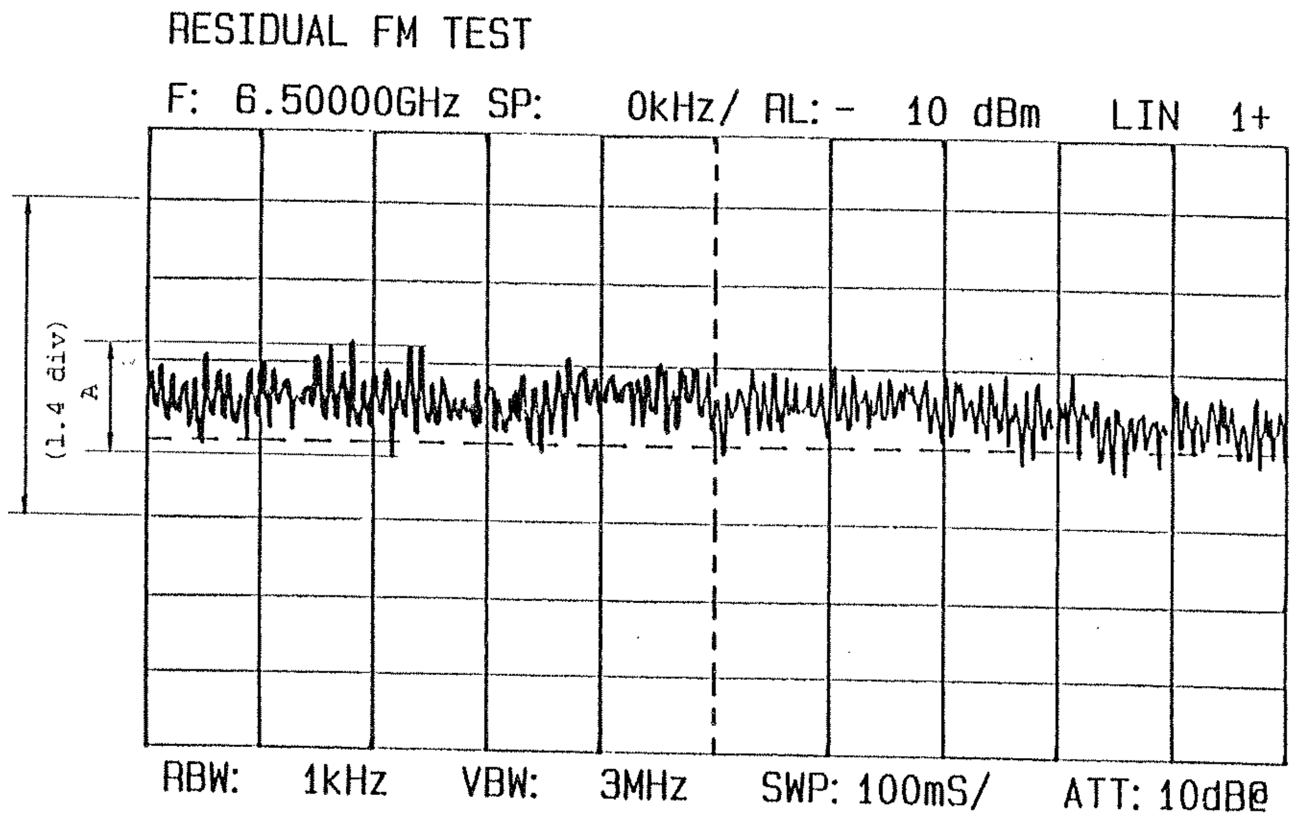



Fig. 8-14 Residual FM Test Sample CRT Display

9. Noise Sidebands

Specifications:

≦ -75 dB (1 kHz resolution bandwidth, 10 Hz video bandwidth, 30 kHz from signal, center frequency ≦ 6.5 GHz)

Data Sheet: Table 8-11

Configuration

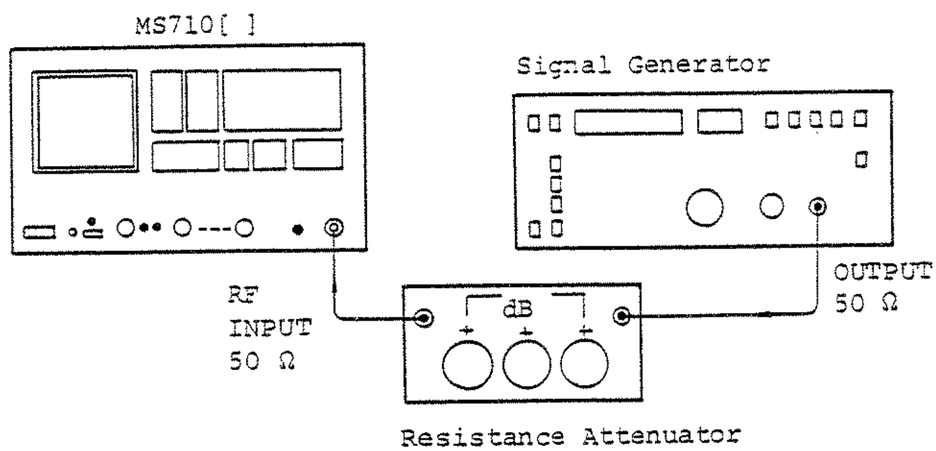



Fig. 8-15 Noise Sidebands Test Setup

Procedure (1.7 to 23 GHz)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 1.7 to 23 GHz<br>CENTER FREQ .................. 6.5 GHz<br>FREQ SPAN/DIV ................ 200 kHz/div<br>REFERENCE LEVEL .............. 0 dBm<br>VERTICAL SCALE ............... LOG 10 dB/div |
| 2 | Set the resistance attenuator to 0 dB.<br>Set the signal generator output as follows:<br>FREQUENCY .................... approx. 6.5 GHz<br>LEVEL ........................ 0 dBm |
| 3 | While setting the trace of the input signal to the center of the screen with the PEAK → CTR and SPAN [∨] functions, reduce the value of the frequency span to SPAN 10 kHz/div. |
| 4 | Set the resistance attenuator to 75 dB. |
| 5 | Set the MS710[ ] reference level to -35 dBm and set the peak to the center horizontal scale line by fine adjusting the signal generator output level. |
| 6 | Set the MS710[ ] VIDEO BW to 10 Hz. |
| 7 | Set the resistance attenuator to 0 dB, and measure the level at ±30 kHz (3 divisions) away from the center frequency, and check that it is below the center scale line (-75 dB). |

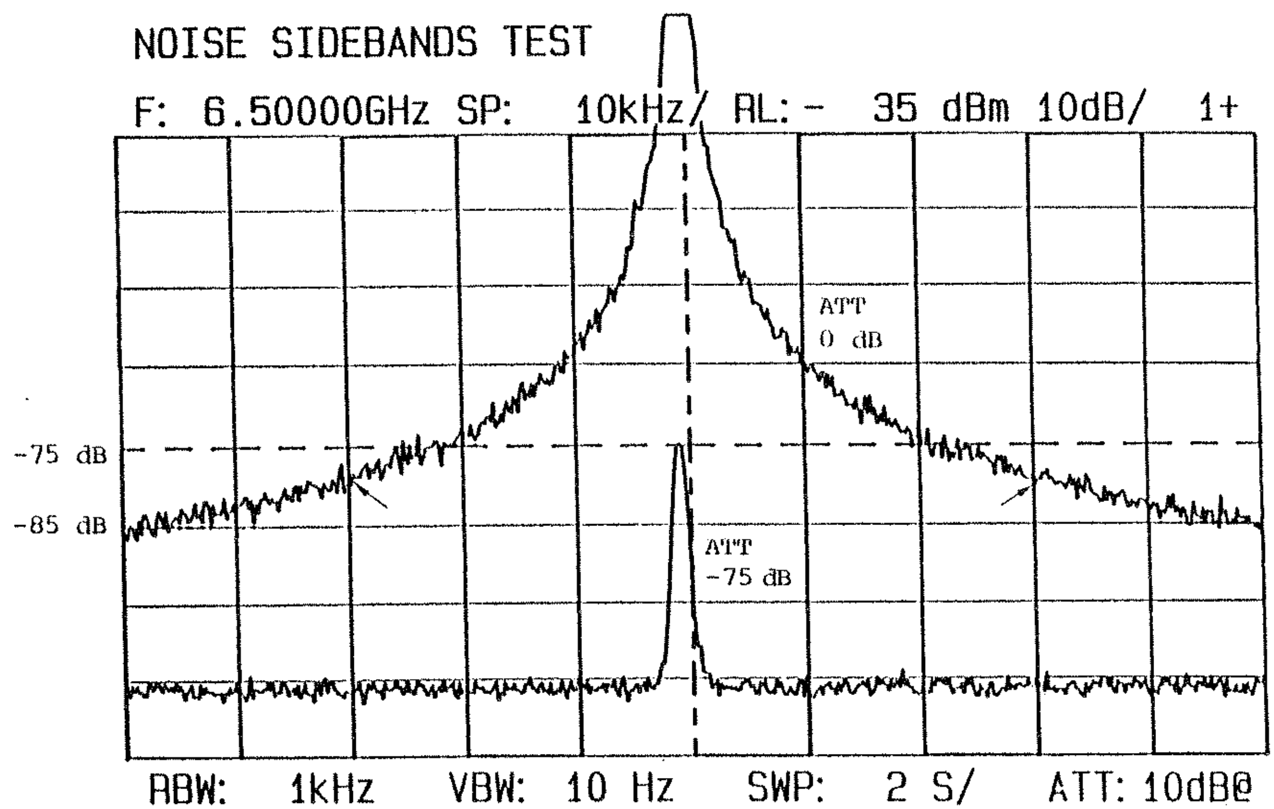



Fig. 8-16 Noise Sidebands Test Sample CRT Display

## 10. Display Linearity

### Specifications

LOG display accuracy: ±0.2 dB/1 dB
Accumulated error : ±1.5 dB/70 dB

Data Sheet: Table 8-12

### Configuration

Same as in Fig. 8-8.

### Procedure

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 100 MHz<br>FREQ SPAN/DIV ................ 50 kHz/div<br>REFERENCE LEVEL .............. -10 dBm<br>VERTICAL SCALE ............... 1 dB/div<br>RES BW ....................... 300 kHz<br>VIDEO BW ..................... 100 Hz<br>INPUT ATTEN .................. 0 dB |
| 2 | Set the resistance attenuator to 0 dB.<br>Set the signal source output as follows:<br>FREQUENCY .................... 100 MHz<br>LEVEL ........................ approx. -10 dBm |
| 3 | Fine-adjust the signal source output level so that the peak of the spectrum trace is on the horizontal top scale line. |

(Continued)

| Step | Procedure |
|---|---|
| 4 | Change the attenuation of the resistance attenuator, so that the peak of the spectrum trace is on the Nth scale line (N = 1 up to 8) from the top horizontal scale line (No. 0), and then read the attenuator setting (Fig. 8-17). |
| 5 | Calculate the error per 1 dB from (Attenuator setting value for scale line No. N) - (Attenuator setting value for scale line No. N-1) - 1. |
| 6 | Calculate the accumulated error for each scale line No. from resistance attenuator setting (actual value) - Attenuator nominal value (scale line No.) |

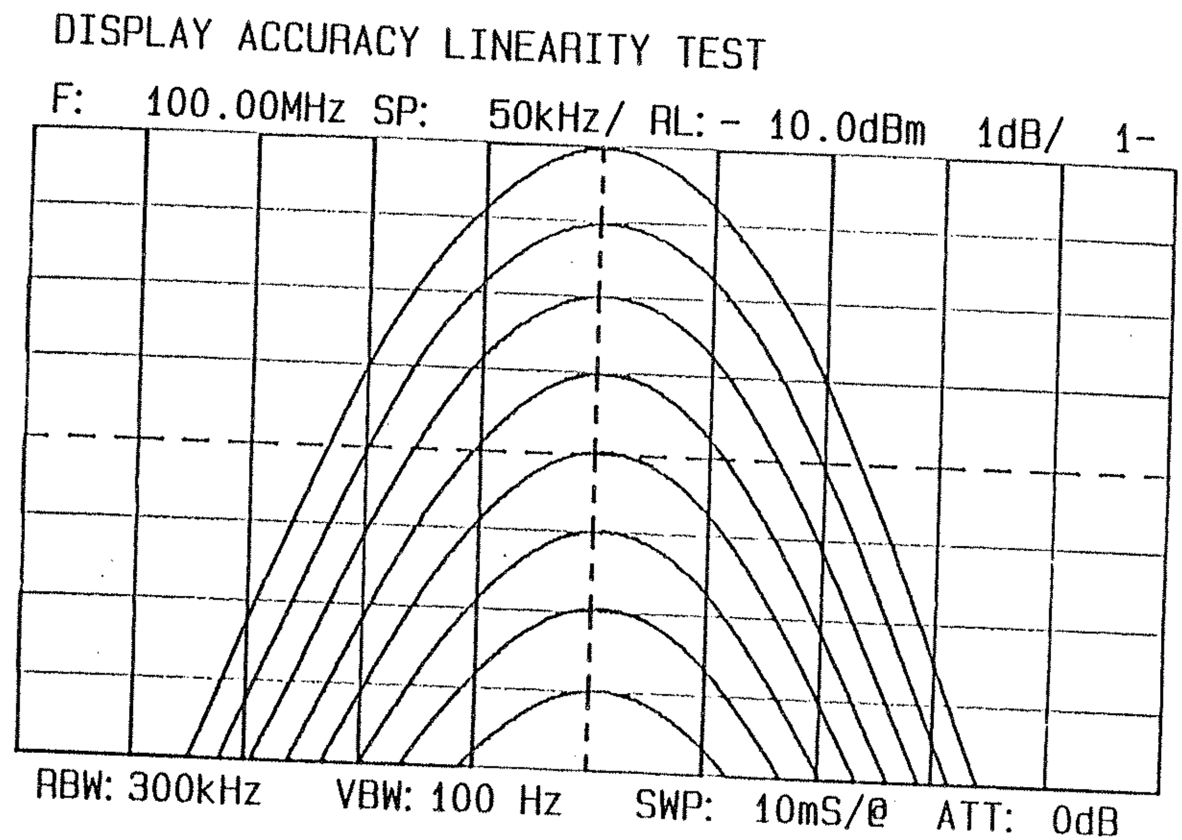



Fig. 8-17 1 dB Step Display Linearity Test Sample CRT Display

(Continued)

| Step | Procedure |
|---|---|
| 7 | Change the MS710[ ] settings as follows:<br>FREQ SPAN/DIV .............. 0.50 MHz/div<br>VERTICAL SCALE .............. LOG 10 dB/div |
| 8 | Set the resistance attenuator to 0 dB, and check that the peak of the spectrum trace coincides with the top horizontal scale line (REFERENCE LEVEL) (error within ±1 dB). |
| 9 | Set the peak of the spectrum trace to the top horizontal scale line by fine adjusting the signal source output level. |
| 10 | Change the attenuation of the resistance attenuator so that the peak of the spectrum trace is on the Nth scale line (N=1 up to 7) from the top horizontal scale line (No. 0), and then read resistance attenuator setting. (Fig. 8-15) |
| 11 | Calculate the error per 10 dB and the accumulated error as described in Steps 5 and 6. However, make the resistance attenuator nominal value of Step 6, the scale line No. x 10 shown in Table 8-14. |

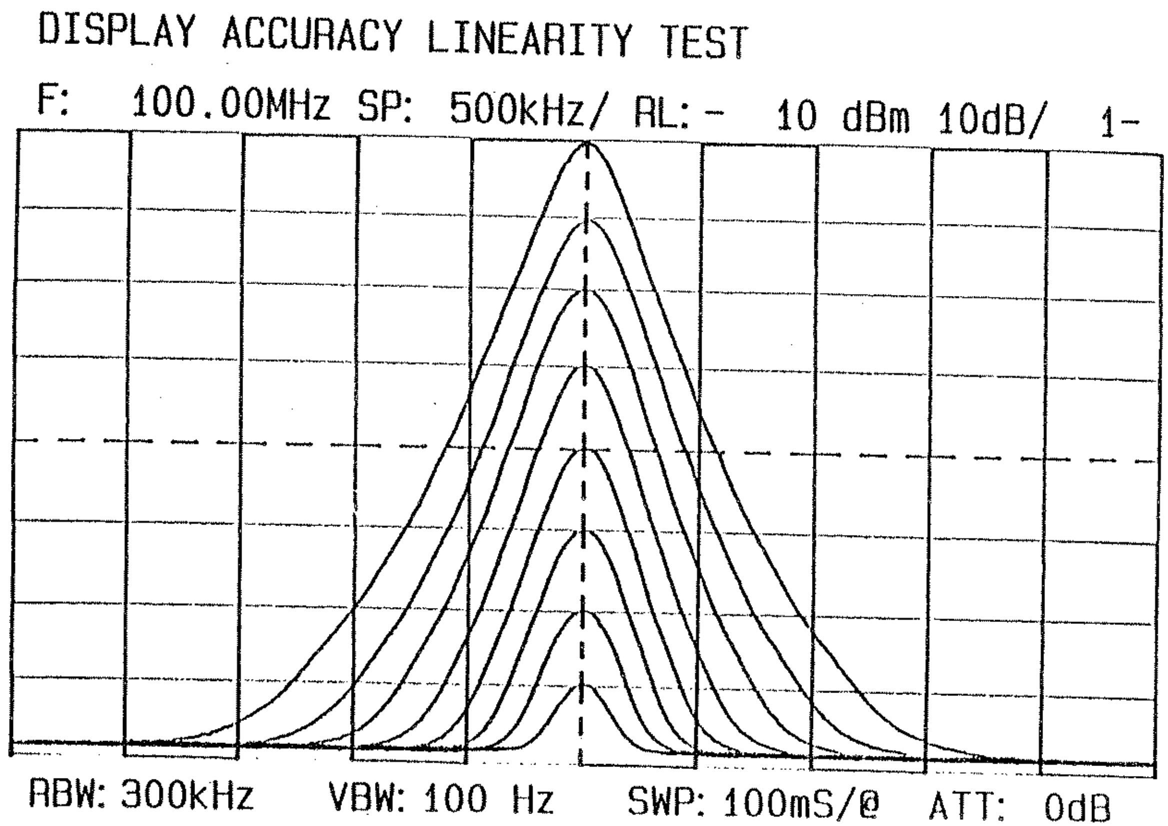



Fig. 8-18 10 dB Step Display Linearity Test Sample CRT Display

11. Screen Display (Log Scale) Switching Error

Specifications

±1 dB

Data Sheet: Table 8-13

Configuration

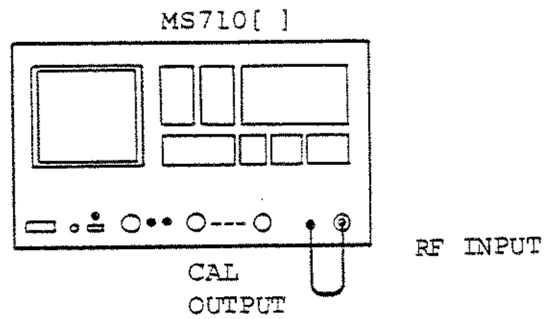



Fig. 8-19 Screen Display (Log Scale) Switching Error Test Setup

Procedure

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 100.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>REFERENCE LEVEL .............. -10 dBm<br>VERTICAL SCALE ............... LOG 1 dB/div |
| 2 | Read the CAL signal level (Pr) with the MS710[ ] peak marker function. |

(Continued)

| Step | Procedure |
|---|---|
| 3 | Change the log scale from 1 to 10, to 5, and 2 dB/div, in that order. Read the CAL signal levels (Px) of the changed log scales with the MS710[ ] peak marker function in the same way as in Step 2.<br><br>Calculate the screen display (log scale) switching error E (dB) from the following equation:<br><br>$E = Px - Pr$ (dB) |

12. Reference Level Accuracy

Specifications

±2.0 dB (reference level -99 to -10 dBm, frequency 100 MHz, input attenuator 0 dB, after calibration using CAL OUTPUT).

Data Sheet: Table 8-14

Configuration

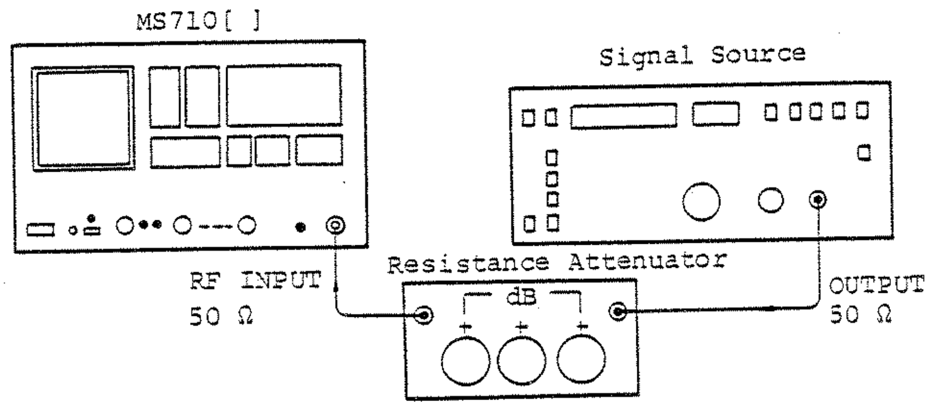



Fig. 8-20 Reference Level Accuracy Test Setup

Procedures

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 100 MHz<br>FREQ SPAN/DIV ................ 1 kHz/div<br>RES BW ....................... 1 kHz<br>REFERENCE LEVEL .............. -10 dBm<br>VERTICAL SCALE ............... LOG 1 dB/div<br>INPUT ATTEN .................. 0 dB |

(Continued)

| Step | Procedure |
|---|---|
| 2 | Set the Resistance Attenuator to 0 dB.<br><br>Fine-adjust the signal source output level so that the peak of the spectrum trace is on the top horizontal scale line. (Fig. 8-21 initial setting) |
| 3 | Change the REFERENCE LEVEL setting and the resistance attenuator settings by the same amount simultaneously. Determine the reference level error from the difference between the Resistance Attenuator nominal value (A) and actual value (B) when the peak of the spectrum trace is set to the top horizontal scale line by changing the attenuator setting. (See Table 8-14 Data Sheet) |
| 4 | When the REFERENCE LEVEL setting is ≦ -70 dBm, measurement is difficult because of the influence of noise. Therefore, measure by reducing the Video Filter value, as shown in Fig. 8-22. |

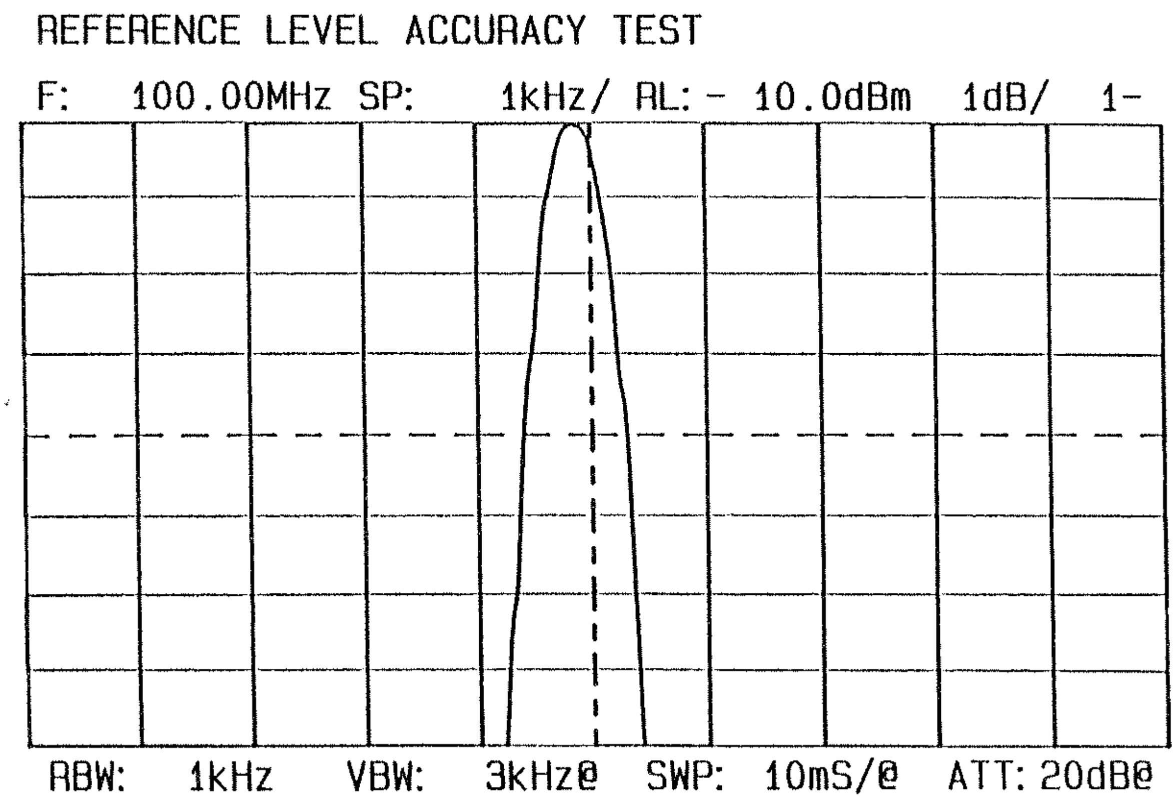



Fig. 8-21 Reference Level Accuracy Test Sample CRT Display (1)
(Initial Setting)

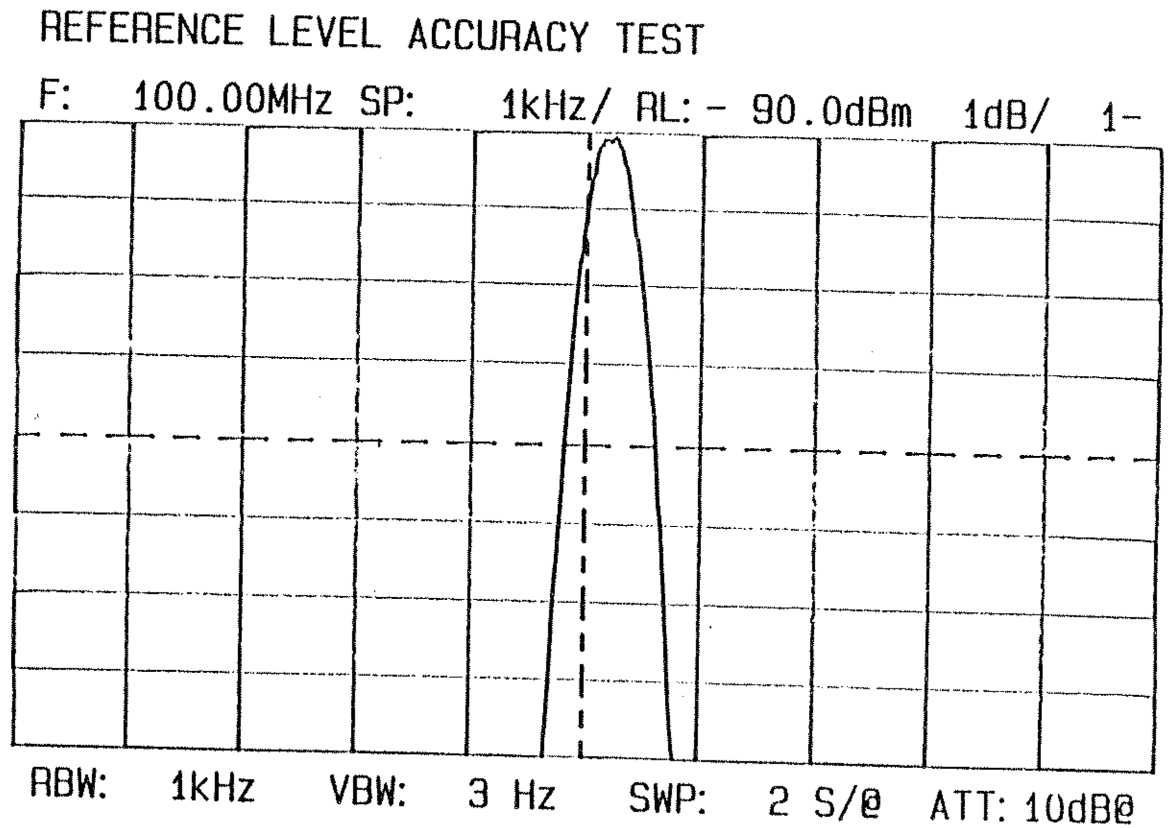



Fig. 8-22 Reference Level Accuracy Test Sample CRT Display (2)

13. Reference Level Frequency Response

Specifications

Using 10 dB input attenuator, and after tuning the preselector to obtain the maximum response by peaking adjustment;

10 kHz to 30 MHz band (MS710C only)

| | |
|---|---|
| ±1.5 dB | (10 kHz start frequency, 30 MHz stop frequency) |

100 kHz to 2 GHz band

| | |
|---|---|
| ±2.5 dB | (100 kHz start frequency, 10 MHz stop frequency) |
| ±1.5 dB | (10 MHz start frequency, 2 GHz stop frequency) |

1.7 to 23 GHz band

| | |
|---|---|
| ±2.5 dB | (1.7 GHz start frequency, 5.478 GHz stop fequency) |
| ±3 dB | (5.478 GHz start frequency, 12.521 GHz stop frequency) |
| ±4 dB | (12.521 GHz start frequency, 23 GHz stop frequency) |

Data Sheet: Table 8-15

Configuration

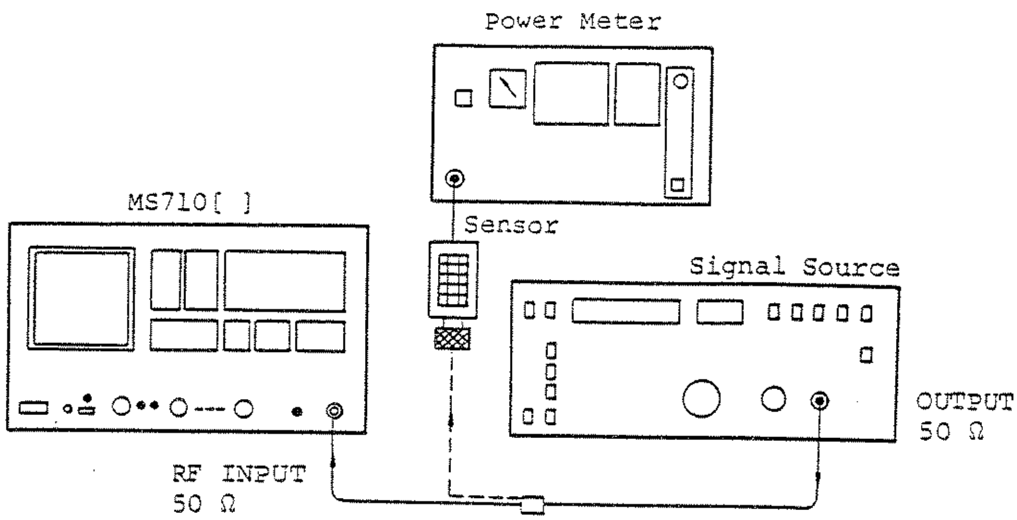



Fig. 8-23 Reference Level Frequency Response Test Setup

Procedure (1.7 to 23 GHz band)

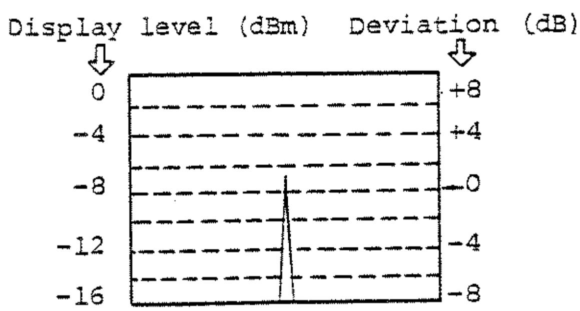
Self-calibration described in paragraph 3.5 must be performed prior to the following procedures.

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 1.7 to 23 GHz<br>CENTER FREQ .................. 1.7 GHz<br>FREQ SPAN/DIV ................ 1 MHz/div<br>REFERENCE LEVEL .............. 0 dBm<br>VERTICAL SCALE ............... LOG 2 dB/div |

(Continued)

| Step | Procedure |
|---|---|
| 2 | Set the signal source frequency to the MS710[ ] center frequency. |
| 3 | Connect the signal source output to the Power Meter through the sensor. Set the signal source output level to -8 dBm. |
| 4 | Connect the signal source output to the MS710[ ]. |
| 5 | Adjust the preselector peak for maximum spectrum trace. (This operation is unnecessary for the 10 kHz to 30 MHz and 100 kHz to 2 GHz bands.) |
| 6 | Read the deviation from the horizontal center scale line (-8 dBm). (see figure shown below.) |

In this example, the deviation is +1.5 dB




| Step | Procedure |
|---|---|
| 7 | Change the MS710[ ] center frequency and the signal source output frequency; determine the deviation at each frequency by a similar procedure to Steps 1 to 6. |

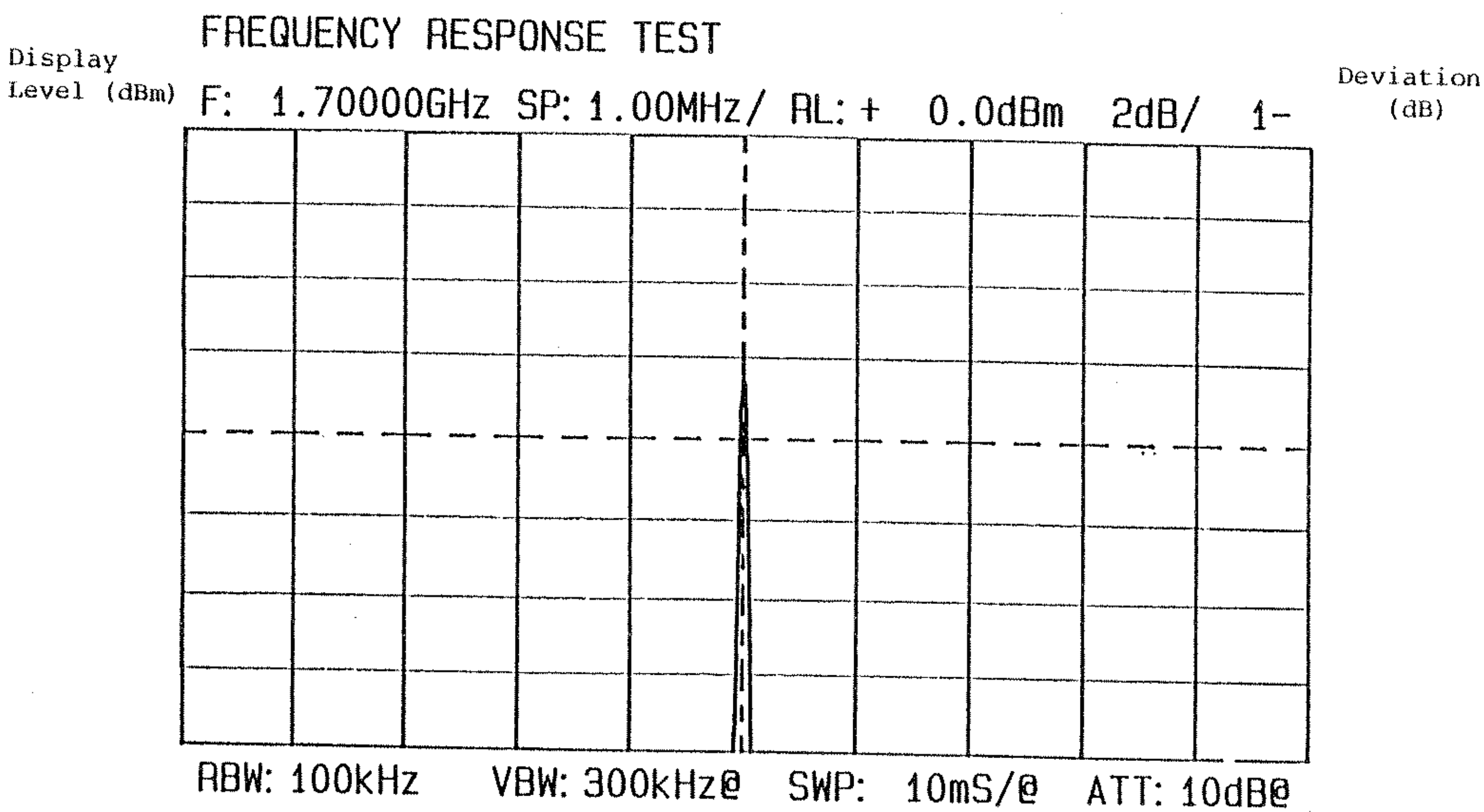



Fig. 8-24 Reference Frequency Response Test
Sample CRT Display

14. Input Attenuator Accuracy

Specifications

The input attenuator setting range is from 0 to 70 dB in 10 dB steps.

The input attenuator can be set manually or automatically coupled to reference level.

Error between steps

≦±1.0 dB/0 to 60 dB, 10 kHz to 2 GHz
≦±2.0 dB/0 to 40 dB, 10 kHz to 23 GHz

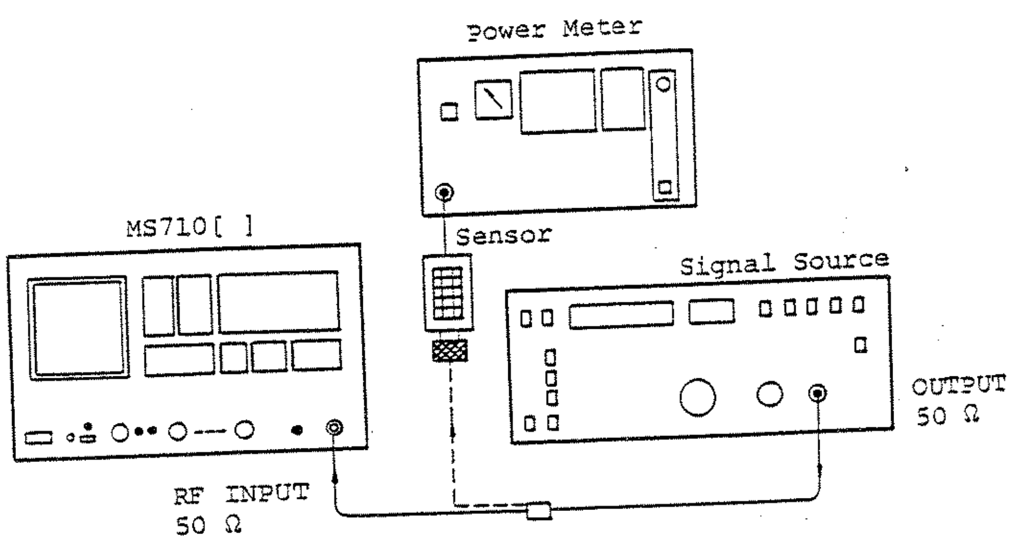
Cumulative error

≦±2.2 dB/0 to 60 dB, 10 kHz to 2 GHz
≦±3.0 dB/0 to 40 dB, 10 kHz to 23 GHz

Data Sheet: Table 8-16

Configuration

(1) 1.7 to 23 GHz



(2) 10 kHz to 2 GHz

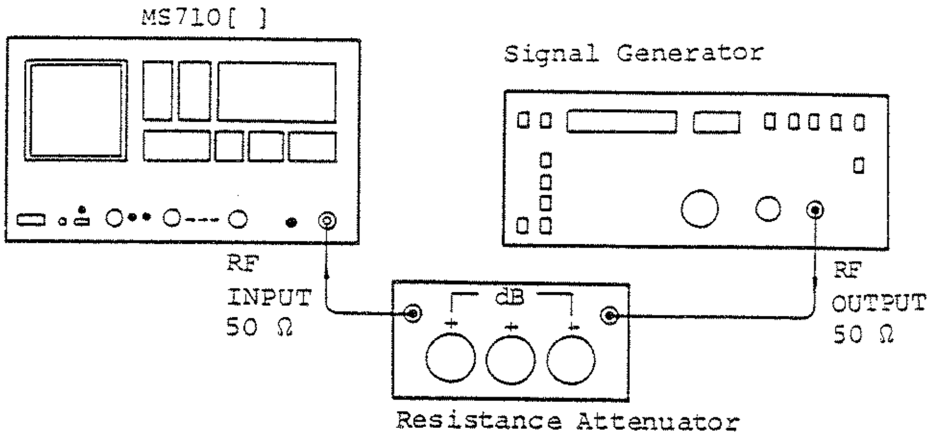



Fig. 8-25 Input Attenuator Accuracy Test Setup

Procedure - 1 (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ...................... 1.7 to 23 GHz band<br>CENTER FREQ .................. 12.5 GHz<br>FREQ SPAN/DIV ................ 1 MHz<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 12.5 GHz<br>LEVEL ........................ 0 dBm<br>(Calibrate using the power meter) |

(Continued)

| Step | Procedure |
|---|---|
| 3 | Fine adjust the signal source frequency so that the MS710[ ] received signal spectrum is set to the approximate screen center. Tune the PRESELECTOR PEAK knob. Read the input signal level ($P_0$) with the MS710[ ] peak marker function. |
| 4 | Change the signal source output level to +10 dBm measuring it by the power meter. |
| 5 | Set the MS710[ ] as follows:<br>INPUT ATTEN ......... 40 dB<br>REFERENCE LEVEL ..... +10 dBm |
| 6 | Read the received signal level ($P_{+10}$) with the MS710C peak marker function. |
| 7 | Change the signal source output level, the input attenuation, and the reference level of the MS710[ ] as shown in the following table and measure the received signal levels using the same procedures as in steps 4 to 6. |

(Continued)

| Step | Procedure |
|---|---|

Measurement Condition

| Signal Source output level | MS710[ ] Spectrum Analyzer | | |
|---|---|---|---|
| | INPUT ATTEN | REFERENCE LEVEL | Received signal level |
| +10 dBm | 40 dB | +10 dBm | $P_{+10}$ = ______ dBm |
| 0 dBm | 30 dB | 0 dBm | $P_{0}$ = ______ dBm |
| -10 dBm | 20 dB | -10 dBm | $P_{-10}$ = ______ dBm |
| -20 dBm | 10 dB | -20 dBm | $P_{-20}$ = ______ dBm |
| -30 dBm | 0 dB | -30 dBm | $P_{-30}$ = ______ dBm |

8 Obtain the interstep errors of the input attenuator steps as follows:

| Attenuator step | Error between steps |
|---|---|
| 40 dB - 30 dB | $(P_{+10} - P_{0}) - 10$ = ______ dB |
| 30 dB - 20 dB | $(P_{0} - P_{-10}) - 10$ = ______ dB |
| 20 dB - 10 dB | $(P_{-10} - P_{-20}) - 10$ = ______ dB |
| 10 dB - 0 dB | $(P_{-20} - P_{-30}) - 10$ = ______ dB |

9 Obtain the cumulative error of the input attenuator as follows:

Cumulative error/0 to 40 dB =

$$(P_{+10} - P_{-30}) - 40 \text{ dB}$$

Procedure - 2 (10 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 1000 MHz<br>FREQ SPAN/DIV ................ 1 MHz<br>INPUT ATTEN .................. 50 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 1000 MHz<br>LEVEL ........................ +10 dBm |
| 3 | Set the attenuation of the resistance attenuator to 10 dB. |
| 4 | Fine-adjust the signal source frequency so that the received signal spectrum of the MS710[ ] is set to the approximate screen center. Then, read the received signal level ($P_0$) with the MS710C peak marker function. |
| 5 | Change the attenuation of the resistance to 0 dB. |
| 6 | Set the MS710[ ] as follows:<br>FREQUENCY .................... 60 dB<br>REFERENCE LEVEL .............. +10 dBm |
| 7 | Read the received signal level ($P_{+10}$) with the MS710[ ] peak marker function. |

(Continued)

| Step | Procedure |
|---|---|
| 8 | Change the attenuation of the resistance attenuator, the input attenuation, and the reference level of the MS710[ ] as shown in the following table, and measure the received signal levels using the same procedures as in steps 5 to 7. |

Measurement Condition

| Resistance attenuator attenuation | MS710[ ] Spectrum Analyzer | | |
|---|---|---|---|
| | INPUT ATTEN | REFERENCE LEVEL | Maximum value of the spectrum trace |
| 0 dB | 60 dB | +10 dBm | $P_{+10}$ = ______ dBm |
| 10 dB | 50 dB | 0 dBm | $P_0$ = ______ dBm |
| 20 dB | 40 dB | -10 dBm | $P_{-10}$ = ______ dBm |
| 30 dB | 30 dB | -20 dBm | $P_{-20}$ = ______ dBm |
| 40 dB | 20 dB | -30 dBm | $P_{-30}$ = ______ dBm |
| 50 dB | 10 dB | -40 dBm | $P_{-40}$ = ______ dBm |
| 60 dB | 0 dB | -50 dBm | $P_{-50}$ = ______ dBm |

| Step | Procedure |
|---|---|
| 9 | Obtain the error between the steps of the input attenuator as follows: |

| Attenuator step | Error between steps |
|---|---|
| 60 dB - 50 dB | $(P_{+10} - P_0) -10$ = ______ dB |
| 50 dB - 40 dB | $(P_0 - P_{-10}) -10$ = ______ dB |
| 40 dB - 30 dB | $(P_{-10} - P_{-20}) -10$ = ______ dB |
| 30 dB - 20 dB | $(P_{-20} - P_{-30}) -10$ = ______ dB |
| 20 dB - 10 dB | $(P_{-30} - P_{-40}) -10$ = ______ dB |
| 10 dB - 0 dB | $(P_{-40} - P_{-50}) -10$ = ______ dB |

(Continued)

| Step | Procedure |
| --- | --- |
| 10 | Obtain the cumulative error of the input attenuator as follows:<br>Cumulative error/0 to 60 dB =<br>$(P_{+10} - P_{-50}) - 50$ (dB) |

15. 2nd Harmonic Distortion

Specifications

10 kHz to 30 MHz band (MS710C only)

≦-60 dB Input Level at Mixer - 40 dBm, 10 kHz to 300 kHz

≦-70 dB Input Level at Mixer - 40 dBm, 300 kHz to 15 MHz

100 kHz to 2 GHz band

≦-60 dB Input Level at Mixer - 40 dBm, 100 kHz to 10 MHz

≦-70 dB Input Level at Mixer - 30 dBm, 10 MHz to 200 MHz

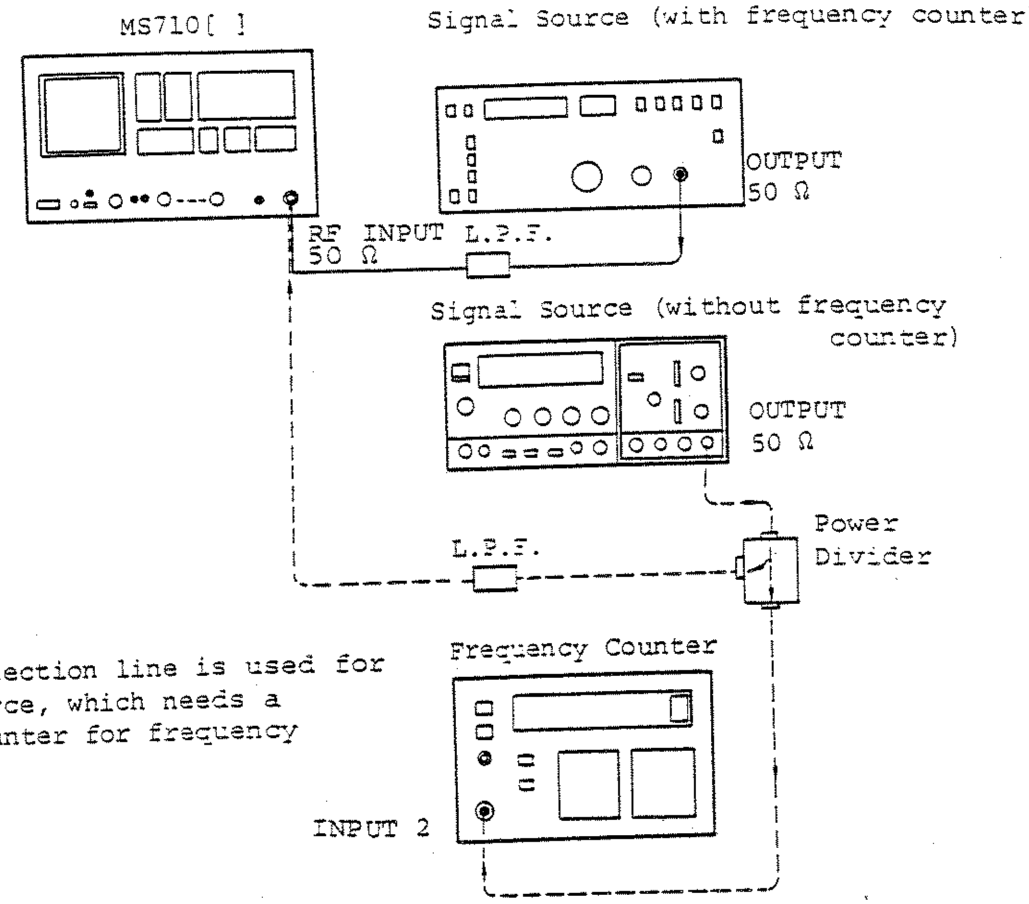
≦-80 dB Input Level at Mixer - 30 dBm, 200 MHz to 850 MHz

1.7 to 23 GHz band

≦-100 dB or Average noise level, Input Level at Mixer - 10 dBm, 850 MHz to 11.5 GHz

Data Sheet: Table 8-17

Configuration




A dotted connection line is used for a signal source, which needs a frequency counter for frequency reading.

Fig. 8-26 2nd Harmonic Distortion Test Setup

Procedure 1-1 (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 5.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>INPUT ATTEN .................. 40 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 5.0 MHz<br>LEVEL ........................ Approx. 0 dBm |
| 3 | Fine adjust the signal source output level ($P_R$) so that it coincides with the MS710[ ] reference level line. |
| 4 | Set the highest level frequency of the received signal to the center frequency with the MS710[ ] PEAK → CTR function. |
| 5 | Set the MS710[ ] as follows:<br>CENTER FREQ .................. Double the frequency set in step 4<br>REFERENCE LEVEL .............. -50 dBm |
| 6 | Lower the FREQ SPAN/DIV to 1 kHz/div by fine adjusting the MS710[ ] center frequency so that the second harmonic of the received signal moves to the screen center. |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Read the second harmonic level ($P_{2f}$) from the MS710C screen. |
| 8 | The second harmonic distortion (D) is given by the following equation: $D = PR-P2f$ (dB) |

Procedure 1-2 (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 100.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 100.0 MHz<br>LEVEL ........................ Approx. 0 dBm |
| 3 | Fine adjust the signal source output level ($P_R$) so that it coincides with the MS710[ ] reference level line. |
| 4 | Set the highest level frequency of the received signal to the center frequency with the MS710[ ] PEAK → CTR function. |
| 5 | Set the MS710[ ] as follows:<br>CENTER FREQ .................. Double the frequency set in step 4.<br>REFERENCE LEVEL .............. -60 dBm |
| 6 | Lower the FREQ SPAN/DIV to 1 kHz/div by fine adjusting the MS710[ ] center frequency so that the second harmonic of the received signal moves to the screen center. |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Read the second harmonic level ($P_{2f}$) from the MS710[ ] screen. |
| 8 | The second harmonic distortion (D) is given by the following equation: $D = P_R - P_{2f}$ (dB) |

Procedure 1-3 (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 500.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 500.0 MHz<br>LEVEL ........................ Approx. 0 dBm |
| 3 | Fine-adjust the signal source output level ($P_R$) so that it coincides with the MS710[ ] reference level line. |
| 4 | Set the highest level frequency of the received signal to the center frequency with the MS710[ ] PEAK → CTR function. |
| 5 | Set the MS710[ ] as follows:<br>CENTER FREQ .................. Double the frequency set in step 4.<br>REFERENCE LEVEL .............. -70 dBm |
| 6 | Lower the FREQ SPAN/DIV to 1 kHz/div by fine-adjusting the MS710[ ] center frequency so that the second harmonic of the received signal moves to the screen center. |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Read the second harmonic level ($P_{2f}$) from the MS710[ ] screen. |
| 8 | The second harmonic distortion (D) is given by the following equation: $D = P_R - P_{2f}$ (dB) |

Procedure 2 (1.7 to 23 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 1.7 to 23 GHz<br>CENTER FREQ .................. 60 GHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>INPUT ATTEN .................. 10 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 6.0 GHz<br>LEVEL ........................ Approx. 0 dBm |
| 3 | Fine-adjust the signal source output level (PR) so that it coincides with the MS710[ ] reference level line. |
| 4 | Set the highest level frequency of the received signal to the center frequency with the MS710[ ] PEAK → CTR function. |
| 5 | Set the MS710[ ] as follows:<br>CENTER FREQ .................. Double the frequency set in step 4.<br>REFERENCE LEVEL .............. −90 dBm |
| 6 | Lower the FREQ SPAN/DIV to 1 kHz/div by fine-adjusting the MS710[ ] center frequency so that the second harmonic of the received signal moves to the screen center. |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Read the second harmonic level ($P_{2f}$) from the MS710[ ] screen. |
| 8 | The second harmonic distortion (D) is given by the following equation: $D = P_R - P_{2f}$ (dB) |

Procedure 3 (10 kHz to 30 MHz band) (MS710C only)

| Step | Procedure |
|---|---|
| 1 | Set the MS710C as follows:<br>FREQ BAND .................... 10 kHz to 30 MHz<br>CENTER FREQ .................. 10.0 MHz<br>FREQ SPAN/DIV ................ 100 kHz/div<br>INPUT ATTEN .................. 40 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Set the signal source output as follows:<br>FREQUENCY (CW) ............... 10.0 MHz<br>LEVEL ........................ Approx. 0 dBm |
| 3 | Fine-adjust the signal source output level (PR) so that it coincides with the MS710C reference level line. |
| 4 | Set the highest level frequency of the received signal to the center frequency with the MS710C PEAK → CTR function. |
| 5 | Set the MS710C as follows:<br>CENTER FREQ .................. Double the frequency set in step 4.<br>REFERENCE LEVEL .............. -50 dBm |
| 6 | Lower the FREQ SPAN/DIV to 1 kHz/div by fine-adjusting the MS710C center frequency so that the second harmonic of the received signal moves to the screen center. |

(Continued)

| Step | Procedure |
|---|---|
| 7 | Read the second harmonic level ($P_{2f}$) from the MS710C screen. |
| 8 | The second harmonic distortion (D) is given by the following equation: $D = P_R - P_{2f}$ (dB) |

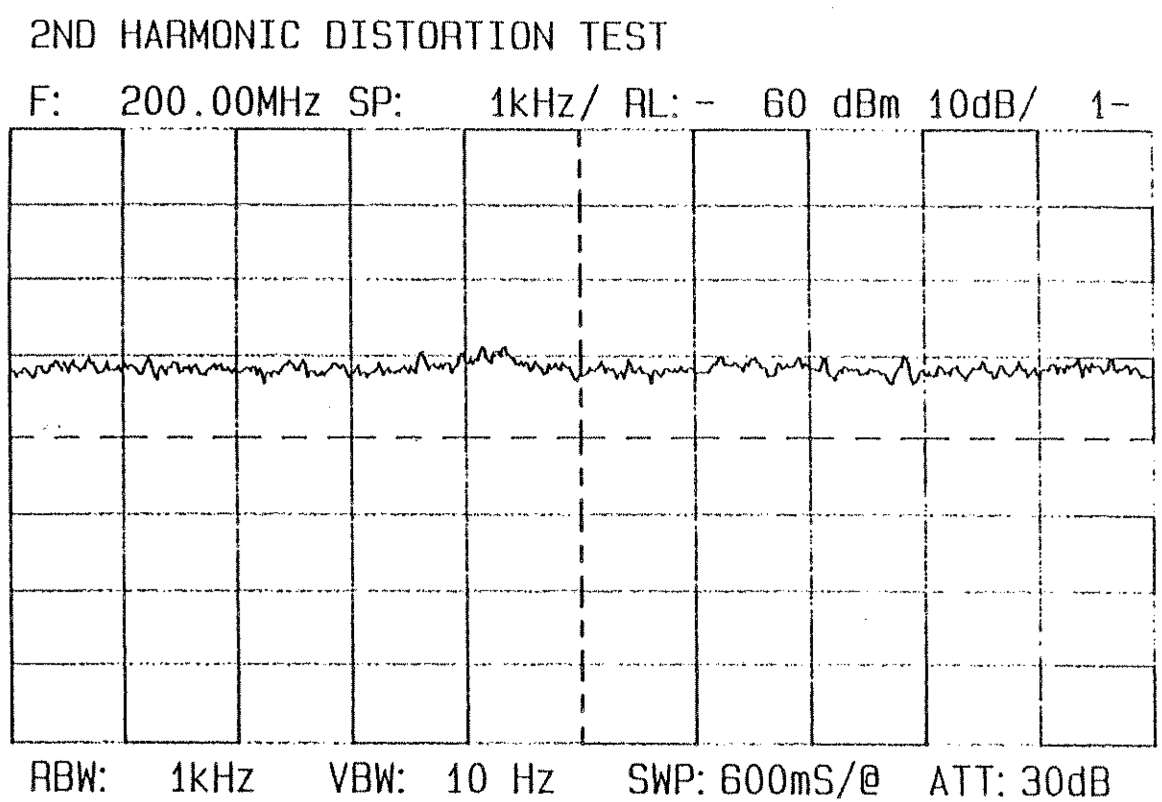



Fig. 8-27 2nd Harmonic Distortion Test Sample CRT Display

16. Two Signal 3rd Order Intermodulation Distortion

Specifications

100 kHz to 2 GHz band

≦-80 dB mixer input level ≦-30 dBm,
frequency difference ≧2.5 MHz

≦-70 dB mixer input level ≦-30 dBm,
frequency difference ≧50 kHz

1.7 to 23 GHz band

≦-100 dB or ≦ average noise level
Mixer input level ≦-10 dBm

Frequency difference ≧70 MHz/1.7 to 12.5 GHz

Frequency difference ≧100 MHz/12.5 to 23 GHz

≦-70 dB mixer input level ≦-30 dBm,
frequency difference ≧50 kHz

10 kHz to 30 MHz band (MS710C only)

≦-70 dB mixer input level ≦-30 dBm,
frequency difference ≧50 kHz

Note:

The mixer input level is obtained by subtracting the input attenuator attenuation from the RF input level.

Data Sheet: Table 8-18

Configuration

(1) 10 kHz to 30 MHz band, 100 kHz to 2 GHz band

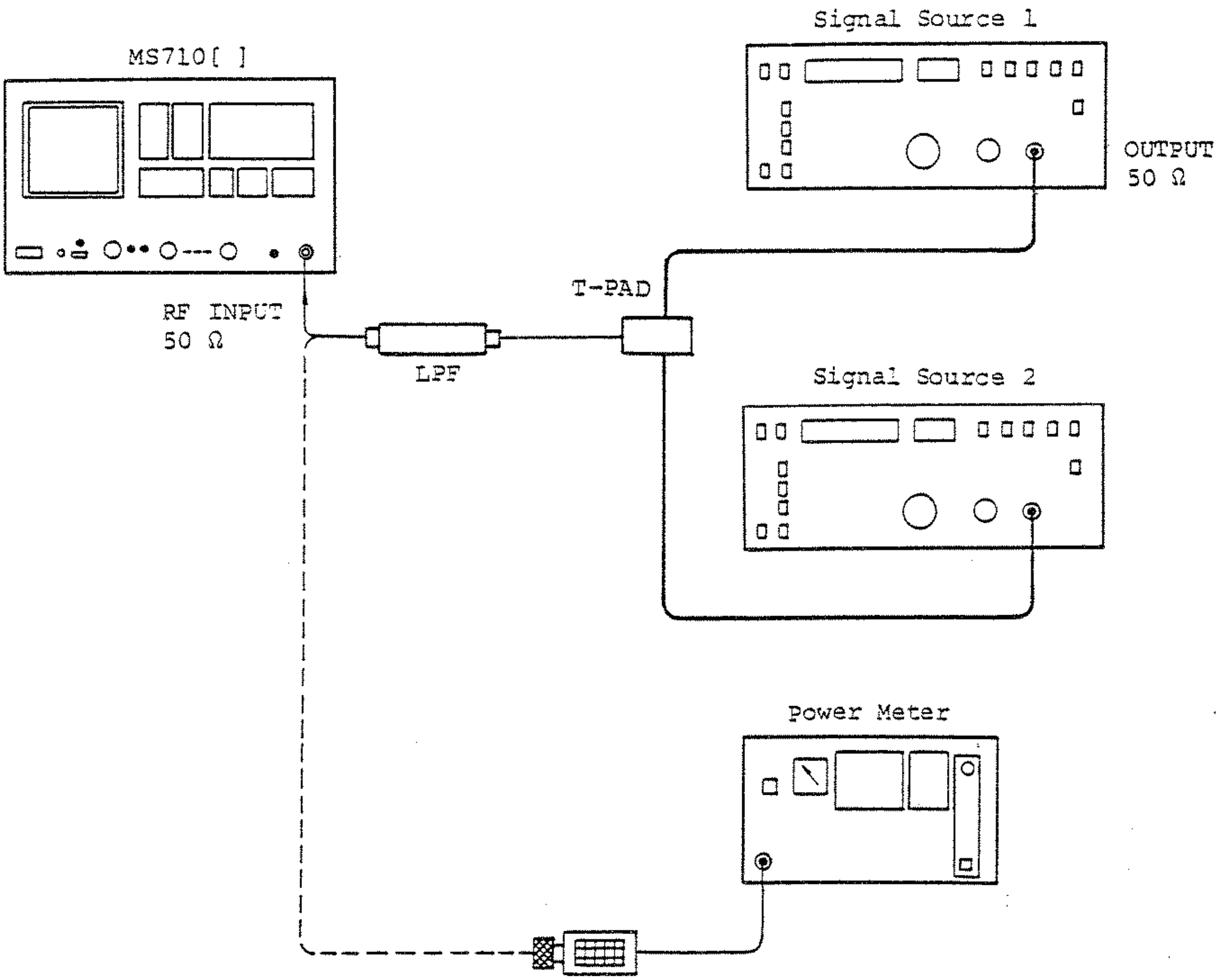



Fig. 8-28 (a) Two Signal 3rd Order Intermodulation Test Setup

(2) 1.7 to 23 GHz band

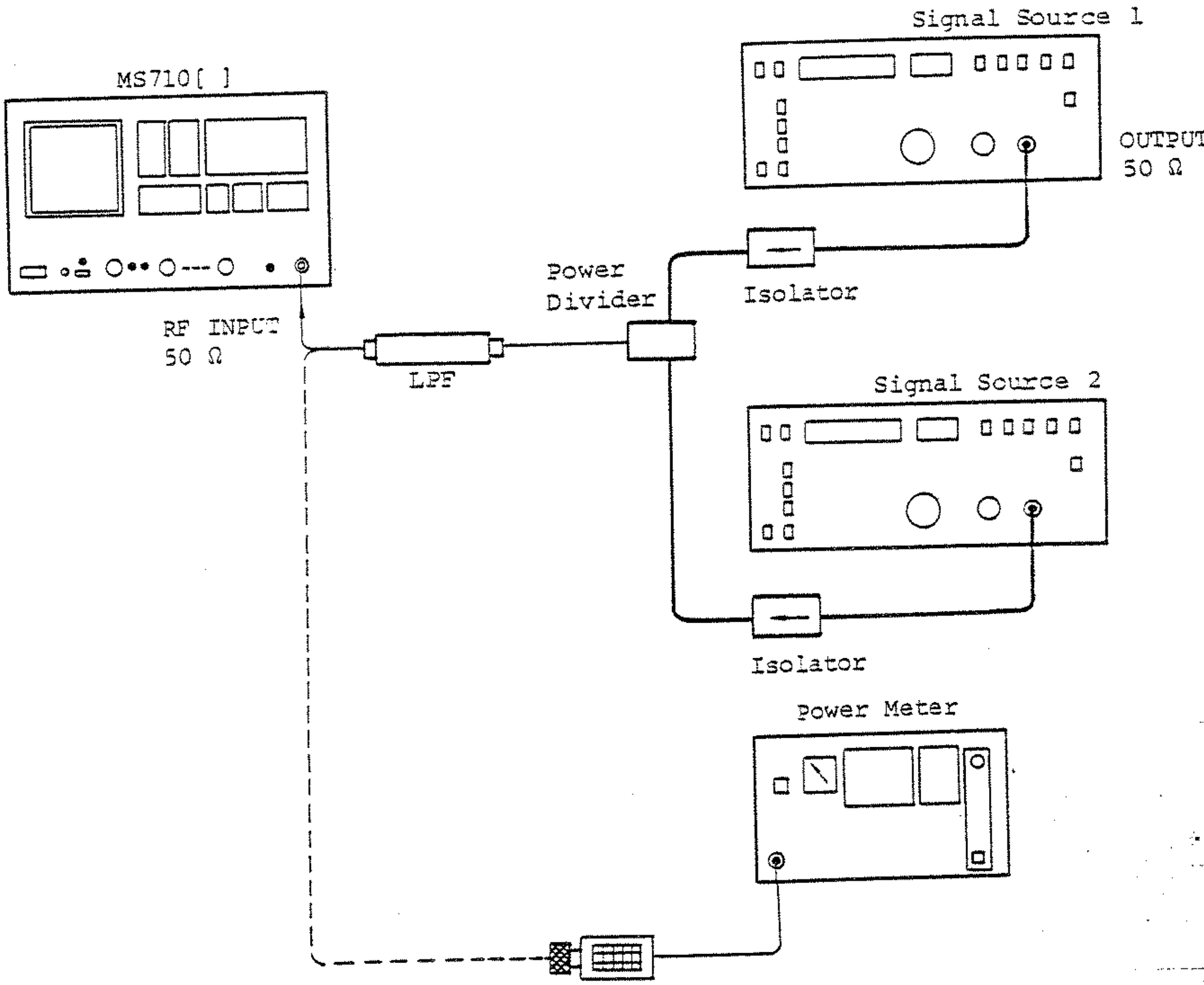



Fig. 8-28 (b) Two Signal 3rd Order Intermodulation Test Setup

Procedure 1 (100 kHz to 2 GHz band)

Two Signal 3rd Order Intermodulation Distortion Test

| Step | Procedure |
|---|---|
| | 2.5 MHz frequency difference: |
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ .................. 1000 MHz<br>FREQ SPAN/DIV ................ 1 MHz/DIV<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Combine the outputs of the signal sources 1 and 2 with the T-PAD as shown in Fig. 8-28 (a) and eliminate the higher harmonic with the LPF. Then, connect the outputs of the LPF to the power meter. |
| 3 | Set the signal source 1 as follows:<br>LEVEL ........ Adjust to -3 dBm at the outputs of the LPF (output of the signal source 2 is off). |
| 4 | Set the signal source 2 as follows:<br>LEVEL ........ Adjust to -3 dBm at the outputs of the LPF (output of the signal source 1 is off). |
| 5 | Confirm that the power meter indication is 0 dBm when the outputs of the signal sources 1 and 2 are turned on. Then, connect the outputs of the LPF to the MS710[ ] RF INPUT. |

(Continued)

| Step | Procedure |
|---|---|

6. Narrow the frequency span, resolution bandwidth, and video bandwidth as follows holding the 1000 MHz signal (F1) in the screen center by fine-adjusting the center frequency, and then read a level of the 1000 MHz signal (Ps).

FREQ SPAN ............ 10 kHz/DIV
RES BW ............... 1 kHz
VIDEO BW ............. 100 Hz

7 Spurious signal is generated on the following frequencies by the two signal 3rd order intermodulation distortion characteristic of the MS710[ ].

$$\left(\begin{aligned} F3 &= 2 \times F1 - F2 \\ &= 2 \times 1000 - 1002.5 \\ &= 997.5\ [\mathrm{MHz}] \end{aligned}\right) \text{ or } \left(\begin{aligned} F3 &= 2 \times F2 - F1 \\ &= 2 \times 1002.5 - 1000 \\ &= 1005\ [\mathrm{MHz}] \end{aligned}\right)$$

Set the MS710[ ] as follows and read the spurious signal (F3) level ($P_T$).

CENTER FREQ .......... 997.5 MHz (or 1005 MHz)
(Fine-adjust so that spurious signal F3 moves to the screen center).
FREQ SPAN/DIV ........ 10 kHz
INPUT ATTEN .......... 30 dB
REFERENCE LEVEL ...... 40 dBm
RES BW ............... 1 kHz
VIDWO BW ............. 100 Hz

8 Obtain the two signal 3rd order intermodulation distortion (D3) from the following equation:

$$D3 = (Ps + 3) - P_T \text{ [dB]}$$

(Continued)

| Step | Procedure |
|---|---|
| | 50 kHz frequency difference: |
| 9 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 100 kHz to 2 GHz<br>CENTER FREQ ................. 1000 MHz<br>FREQ SPAN/DIV .............. 20 kHz/DIV<br>INPUT ATTEN ................. 30 dB<br>REFERENCE LEVEL ............. 0 dBm |
| 10 | Combine the outputs of signal sources 1 and 2 with the T-PAD as shown in Fig. 8-28 (a). Then, eliminate the higher harmonic with the LPF. Connect the outputs of the LPF to the power meter. |
| 11 | Set the signal source 1 as follows:<br>Frequency (CW) .. 1000 MHz (F1)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 2 is off). |
| 12 | Set the signal source 2 as follows:<br>Frequency (CW) .. 1000.05 MHz (F2)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 1 is off.) |
| 13 | Confirm that the power meter indication is 0 dBm when the outputs of the signal source 1 and 2 are turned on. Then, connect the outputs of the LPF to the MS710[ ] RF INPUT. |

(Continued)

| Step | Procedure |
|---|---|
| 14 | Narrow the frequency span, resolution bandwidth, and video bandwidth as follows holding the 1000 MHz signal (F1) in the screen center by fine-adjusting the center frequency, and then read a level of the 1000 MHz signal (Ps).<br><br>FREQ SPAN ................... 10 kHz/DIV<br>RES BW ...................... 1 kHz<br>VIDEO BW .................... 100 Hz |
| 15 | Spurious signal is generated on the following frequencies by the two signal 3rd order intermodulation distortion characteristics of the MS710[ ].<br><br>( F3 = 2 x F1 - F2 = 2 x 1000 - 1000.05 = 999.95 [MHz] ) or ( F3 = 2 x F2 - F1 = 2 x 1000.05 - 1000 = 1000.1 [MHz] )<br><br>Set the MS710[ ] as follows and read the spurious signal (F3) level ($P_T$).<br><br>CENTER FREQ .......... 999.95 MHz (or 1000.1 MHz) (Fine-adjust so that spurious signal F3 moves to the screen center.)<br>FREQ SPAN/DIV ........ 10 kHz<br>INPUT ATTEN .......... 30 dB<br>REFERENCE LEVEL ...... -40 dBm<br>RES BW ............... 1 kHz<br>VIDEO BW ............. 100 Hz |

(Continued)

| Step | Procedure |
|---|---|
| 16 | Obtain the two signal 3rd order intermodulation distortion (D3) of the MS710[ ] from the following equation: $$D3 = (Ps + 3) - P_T \text{ (dB)}$$ |

Procedure 2 (1.7 to 23 GHz band)

Two Signal 3rd Order Intermodulation Distortion Test

| Step | Procedure |
|---|---|
| | 70/100 MHz frequency difference: |
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND .................... 1.7 to 23 GHz<br>CENTER FREQ .................. 7 GHz<br>FREQ SPAN/DIV ................ 20 MHz/DIV<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Combine the outputs of the signal sources 1 and 2 with the power combiner as shown in Fig. 8-28 (b). Then, eliminate the higher harmonic with the LPF.<br>Connect the outputs of the LPF to the power meter. |
| 3 | Set the signal source 1 as follows:<br>Frequency (CW) .. 7 GHz (F1)<br>LEVEL .......... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 2 is off). |
| 4 | Set the signal source 2 as follows:<br>Frequency (CW) .. 7.07 GHz (F2)<br>LEVEL .......... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 1 is off). |
| 5 | Confirm that the power meter indication is 0 dBm when the outputs of the signal sources 1 and 2 are turned on. Then, connect the outputs of the LPF to the MS710[ ] RF INPUT. |

(Continued)

| Step | Procedure |
|---|---|
| 6. | Narrow the frequency span, resolution bandwidth, and video bandwidth as follows holding the 7 GHz signal (F1) in the screen center by fine-adjusting the center frequency, and then read a level of the 7 GHz signal (Ps).<br><br>FREQ SPAN .................... 10 kHz/DIV<br>RES BW ........................ 1 kHz<br>VIDEO BW ..................... 100 Hz |
| 7 | Spurious signal is generated on the following frequencies by the two signal 3rd order intermodulation distortion characteristic of the MS710[ ].<br><br>$\left(\begin{aligned} F3 &= 2 \times F1 - F2 \\ &= 2 \times 7 - 7.07 \\ &= 6.93\ [GHz] \end{aligned}\right)$ or $\left(\begin{aligned} F3 &= 2 \times F2 - F1 \\ &= 2 \times 7.07 - 7 \\ &= 7.14\ [GHz] \end{aligned}\right)$<br><br>Set the MS710[ ] as follows and read the spurious signal (F3) level ($P_T$).<br><br>CENTER FREQ .......... 6.93 GHz (or 7.14 GHz) (Fine-adjust so that the spurious signal F3 moves to the screen center).<br>FREQ SPAN/DIV ........ 10 kHz<br>INPUT ATTEN ......... 30 dB<br>REFERENCE LEVEL ...... -40 dBm<br>RES BW ............... 1 kHz<br>VIDEO BW ............. 100 Hz |

(Continued)

| Step | Procedure |
|---|---|
| 8 | Obtain the two signal 3rd order intermodulation distortion (D3) from the following equation: $$D3 = (Ps + 3) - P_T \text{ [dB]}$$ Two Signal 3rd Order Intermodulation Distortion Test 50 kHz frequency difference: |
| 9 | Set the MS710[ ] as follows:<br>FREQ BAND .................. 1.7 to 23 GHz<br>CENTER FREQ ................. 12.5 GHz<br>FREQ SPAN/DIV ............... 1 MHz/DIV<br>INPUT ATTEN ................. 30 dB<br>REFERENCE LEVEL ............. 0 dBm |
| 10 | Combine the outputs of the signal sources 1 and 2 with the power combiner as shown in Fig. 8-28 (b). Then, eliminate the higher harmonic with the LPF.<br>Connect the outputs of the LPF to the power meter. |
| 11 | Set the signal source 1 as follows:<br>Frequency (CW) .. 12.5 GHz (F1)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 2 is off). |
| 12 | Set the signal source 2 as follows:<br>Frequency (CW) .. 12.5005 GHz (F2)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 1 is off.) |

(Continued)

| Step | Procedure |
|---|---|
| 13 | Confirm that the power meter indication is 0 dBm when the outputs of the signal sources 1 and 2 are turned on. Then, connect the outputs of the LPF to the MS710[ ] RF INPUT. |
| 14 | Narrow the frequency span, resolution bandwidth, and video bandwidth as follows holding the 12.5 GHz signal (F1) in the screen center by fine-adjusting the center frequency, and then read a level of the 12.5 GHz signal (Ps).<br><br>FREQ SPAN .................... 10 kHz/DIV<br>RES BW ...................... 1 kHz<br>VIDEO BW .................... 100 Hz |

(Continued)

| Step | Procedure |
|---|---|
| 15 | Spurious signal is generated on the following frequencies by the two signal 3rd order intermodulation distortion characteristics of the MS710[ ]. |

$$\left(\begin{aligned} F3 &= 2 \times F1 - F2 \\ &= 2 \times 12500 - 12500.05 \\ &= 12499.95 \text{ [MHz]} \end{aligned}\right) \text{or} \left(\begin{aligned} F3 &= 2 \times F2 - F1 \\ &= 2 \times 12500.05 - 12500 \\ &= 12500.1 \text{ [MHz]} \end{aligned}\right)$$

Set the MS710[ ] as follows and read the spurious signal (F3) level ($P_T$).

CENTER FREQ .......... 12.5 GHz (Fine-adjust so that the spurious signal F3 moves to the screen center.)

FREQ SPAN/DIV ........ 10 kHz

INPUT ATTEN ......... 30 dB

REFERENCE LEVEL ...... -40 dBm

RES BW ............... 1 kHz

VIDEO BW ............. 100 Hz

| Step | Procedure |
|---|---|
| 16 | Obtain the two signal 3rd order intermodulation distortion (D3) of the MS710[ ] from the following equation: |

$$D3 = (Ps + 3) - P_T \text{ (dB)}$$

Procedure 3 (10 kHz to 30 MHz band) (MS710C only)

| Step | Procedure |
|---|---|
| 1 | Set the MS710C as follows:<br>FREQ BAND .................... 10 kHz to 30 MHz<br>CENTER FREQ .................. 15 MHz<br>FREQ SPAN/DIV ................ 20 kHz/DIV<br>INPUT ATTEN .................. 30 dB<br>REFERENCE LEVEL .............. 0 dBm |
| 2 | Synthesize the outputs of the signal 1 and 2 with the T-PAD as shown in Fig. 8-28 (a).<br>Then, eliminate the higher harmonic with the LPF. Connect the outputs of the LPF to the power meter. |
| 3 | Set the signal source 1 as follows:<br>Frequency (CW) .. 15 MHz (F1)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 2 is off). |
| 4 | Set the signal source 2 as follows:<br>Frequency (CW) .. 15.05 MHz (F2)<br>LEVEL ........... Adjust to -3 dBm at the outputs of the LPF (output of the signal source 1 is off). |
| 5 | Confirm that the power meter indication is 0 dBm when the outputs of the signal sources 1 and 2 are turned on. Then, connect the outputs of the LPF to the MS710C RF INPUT. |

(Continued)

| Step | Procedure |
|---|---|
| 6. | Narrow the frequency span, resolution bandwidth, and video bandwidth as follows holding the 15 MHz signal (F1) in the screen center by fine-adjusting the center frequency, and then read a level of the 15 MHz signal (Ps).<br>FREQ SPAN .................... 10 kHz/DIV<br>RES BW ...................... 1 kHz<br>VIDEO BW .................... 100 Hz |
| 7 | Spurious signal is generated on the following frequencies by the two signal 3rd order intermodulation distortion characteristic of the MS710C.<br>(F3 = 2 x F1 - F2 = 2 x 15 - 15.05 = 14.95 [MHz]) or (F3 = 2 x F2 - F1 = 2 x 15.05 - 15 = 15.1 [MHz])<br>Set the MS710C as follows and read the spurious signal (F3) level ($P_T$).<br>CENTER FREQ .......... 14.95 MHz (or 15.1 MHz) (Fine-adjust so that the spurious signal F3 moves to the screen center).<br>FREQ SPAN/DIV ........ 10 kHz<br>INPUT ATTEN .......... 30 dB<br>REFERENCE LEVEL....... -40 dBm<br>RES BW ............... 1 kHz<br>VIDWO BW ............. 100 Hz |

(Continued)

| Step | Procedure |
|---|---|
| 8 | Obtain the two signal 3rd order intermodulation distortion (D3) from the following equation: $D3 = (Ps + 3) - P_T$ [dB] |

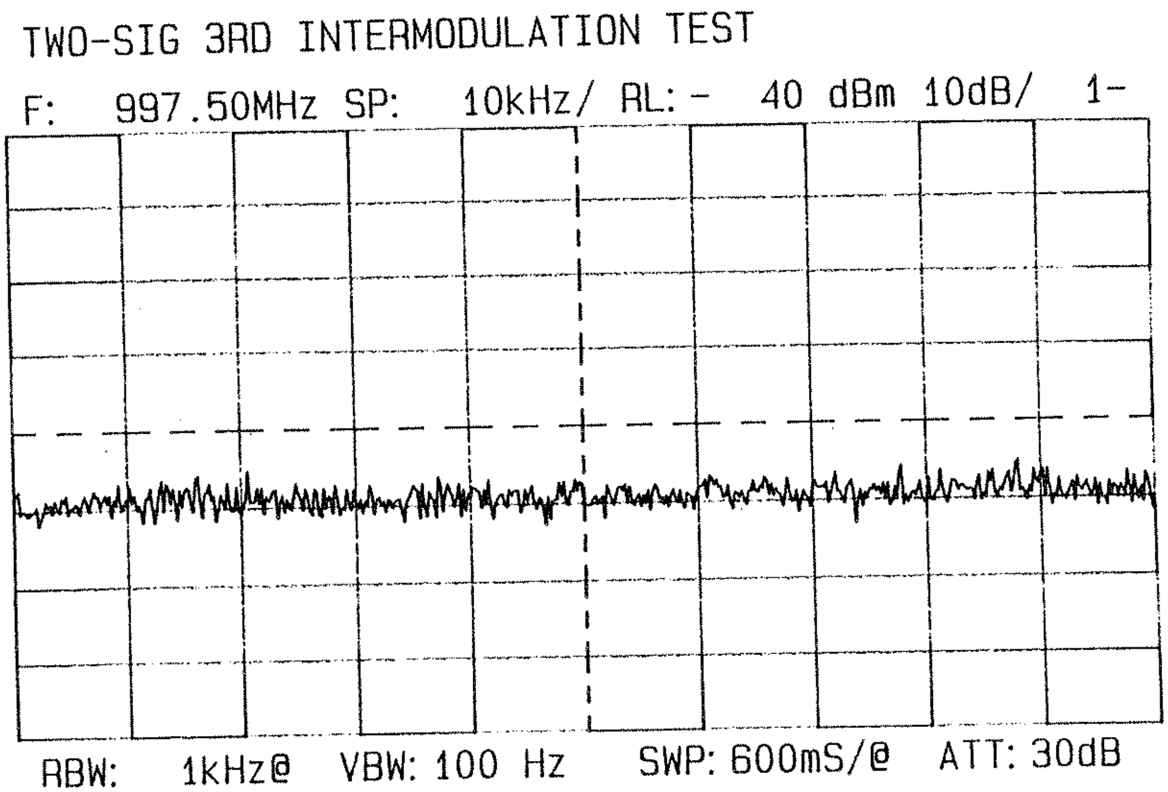



Fig. 8-29 Two Signal, 3rd Order Intermodulation Distortion Test Sample CRT Display

17. Residual Response

Specifications

≦-90 dBm (0 dB input attenuator, 100 kHz to 6.5 GHz fundamental mixing, and 50 Ω termination)

Data Sheet: Table 8-19

Configuration

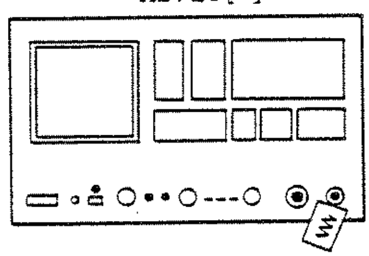



Fig. 8-30 Residual Response Test Setup

Procedure

| Step | Procedure |
| --- | --- |
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ........................ 100 kHz to 2 GHz<br>CENTER FREQ ...................... 25 MHz<br>FREQ SPAN/DIV .................... 5 MHz/div<br>REFERENCE LEVEL .................. -50 dBm<br>VERTICAL SCALE ................... LOG 10 dB/div<br>RES BW ........................... 3 kHz<br>VIDEO BW ......................... AUTO<br>SWEEP TIME ....................... AUTO<br>INPUT ATTEN ...................... 0 dB |

(Continued)

| Step | Procedure |
|---|---|
| 2 | Observe the spectrum trace after one or more complete sweeps have ended (* mark at the top right of the screen disappears) and ensure there is no spectrum trace of ≧-90 dBm (center horizontal axis scale). |
| 3 | Change the center frequency of the MS710[ ] to "current frequency +45 MHz". |
| 4 | Repeat Steps 2 and 3 until the upper frequency limit (2 GHz) of the 100 kHz to 2 GHz band is reached. |
| 5 | After the observing all the frequencies of the 100 kHz to 2 GHz band, set the MS710[ ] as follows:<br>FREQ BAND .................. 1.7 to 23 GHz<br>CENTER FREQ ................ 1.725 GHz<br>Other settings are the same as in Step 1. |
| 6 | Repeat steps 2 and 3 and check whether the residual response is ≦-90 dBm for all the frequencies up to 6.5 GHz. |
| 7 | Change the settings of the MS710[ ] as follows:<br>FREQ BAND .................. 10 kHz to 30 MHz<br>CENTER FREQ ................ 15 MHz<br>FREQ SPAN/DIV .............. 3 MHz/div<br>Other settings are the same as in Step 1. |
| 8 | Confirm that there is no residual response ≧-90 dBm on the screen. |

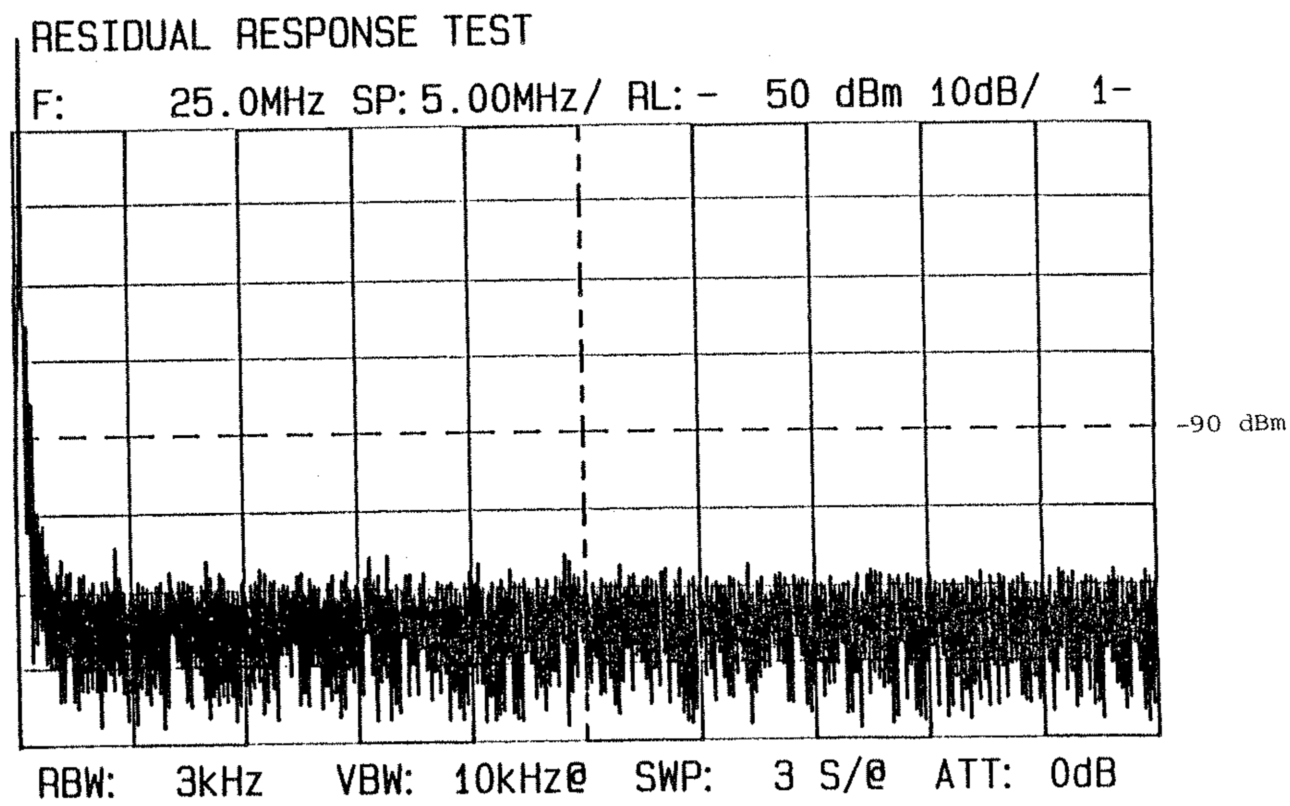



Fig. 8-31 100 kHz to 2 GHz Band Residual Response Test Sample CRT Display (1)

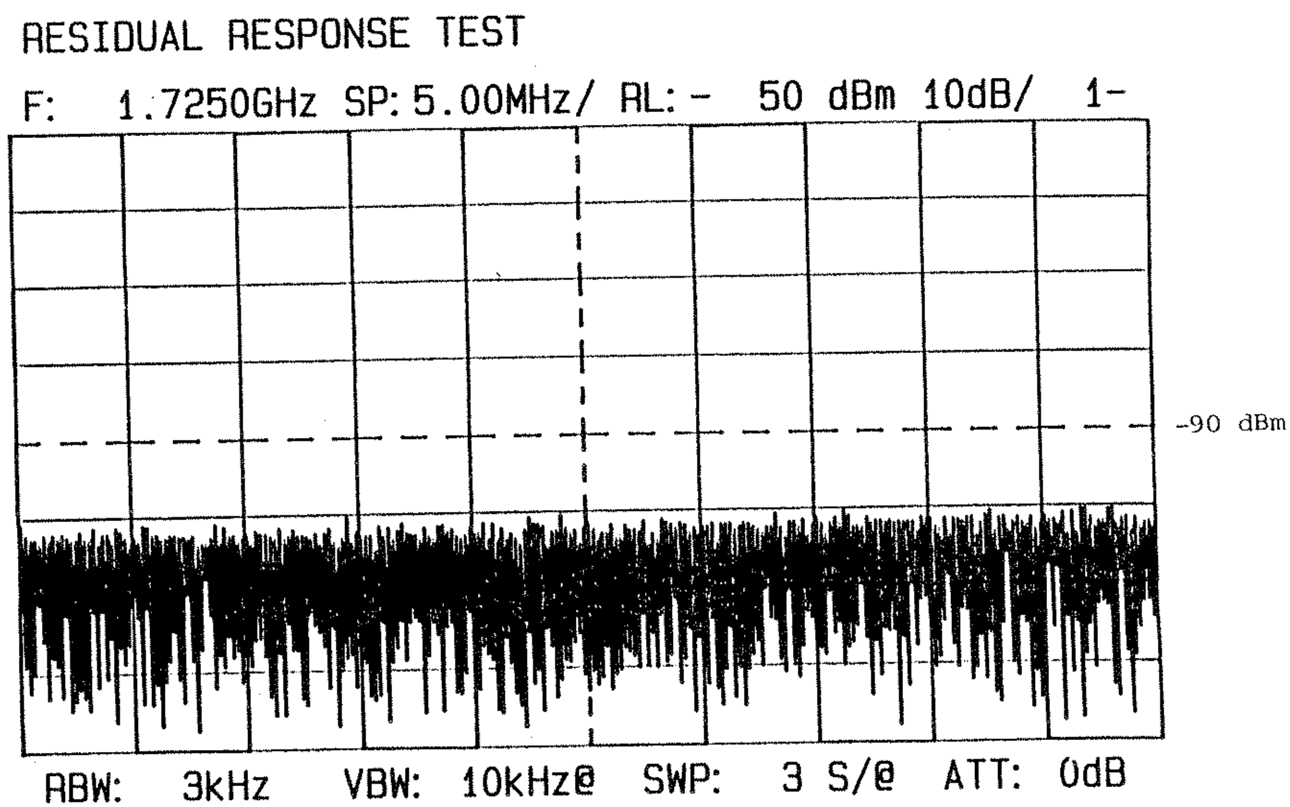



Fig. 8-32 1.7 to 23 GHz Band Residual Response Test Sample CRT Display (2)

18. Average Noise Level

Specifications

1 kHz resolution bandwidth, 0 dB input attenuator, and 3 Hz video bandwidth

10 kHz to 30 MHz band (MS710C only)

≦-95 dBm (100 kHz to 1 MHz)
≦-115 dBm (1 to 30 MHz)

100 kHz to 2 GHz band

≦-95 dBm (100 kHz to 1 MHz)
≦-115 dBm (1 MHz to 2 GHz)

1.7 to 23 GHz band

≦-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)

Data Sheet: Table 8-20

Configuration

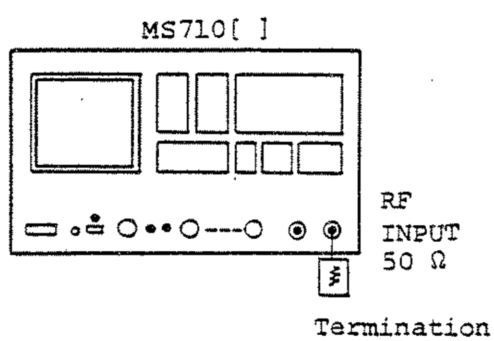



Fig. 8-33 Average Noise Level Test Setup

Procedure (100 kHz to 2 GHz band)

| Step | Procedure |
|---|---|
| 1 | Set the MS710[ ] as follows:<br>FREQ BAND ........................ 100 kHz to 2 GHz<br>CENTER FREQ ..................... 100 kHz<br>FREQ SPAN/DIV .................... 1 kHz/div<br>REFERENCE LEVEL ................. -90 dBm<br>VERTICAL SCALE .................. LOG 5 dB/div<br>RES BW .......................... 1 kHz<br>VIDEO BW ........................ 3 Hz<br>INPUT ATTEN ..................... 0 dB |
| 2 | Read the average noise level from the CRT screen as shown in Fig. 8-34. |
| 3 | Change the center frequency and repeat Step 2. |

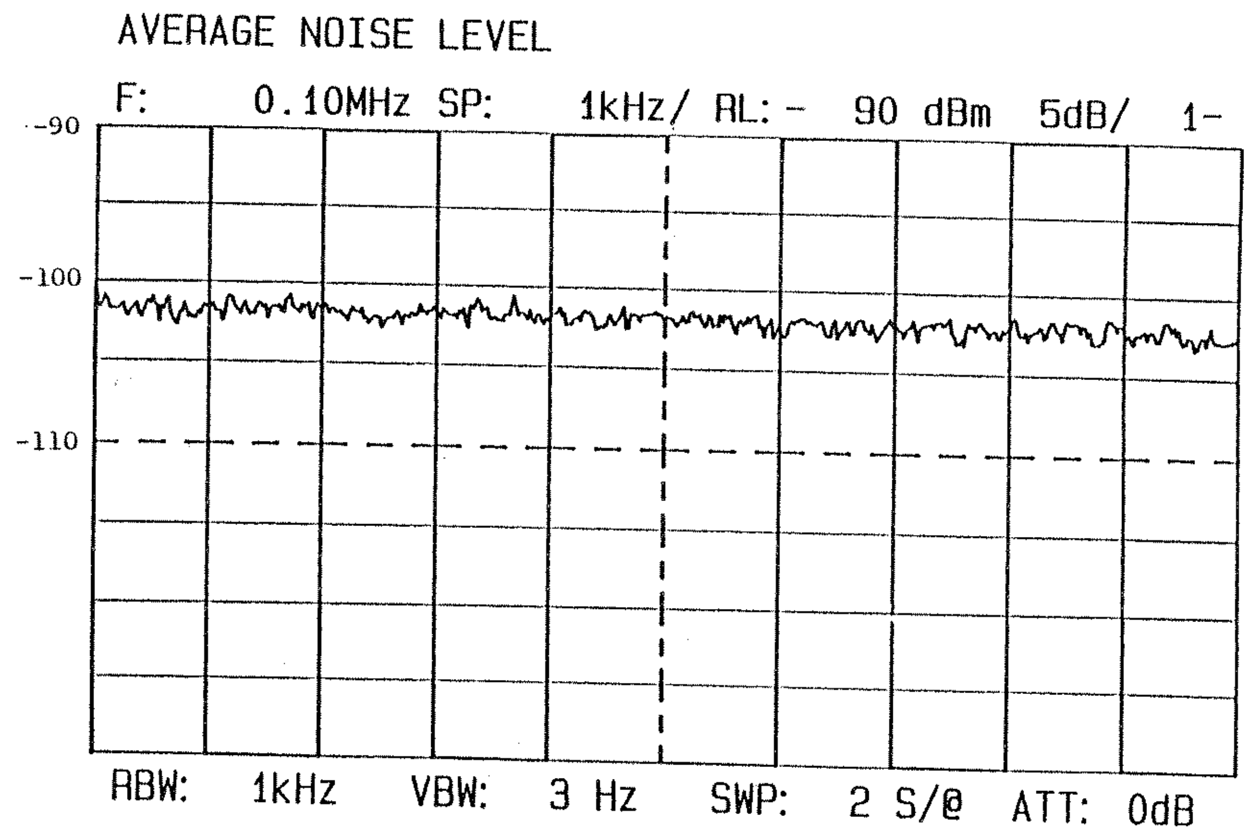



Fig. 8-34 100 kHz to 2 GHz Band Average Noise Test Sample CRT Display (1)

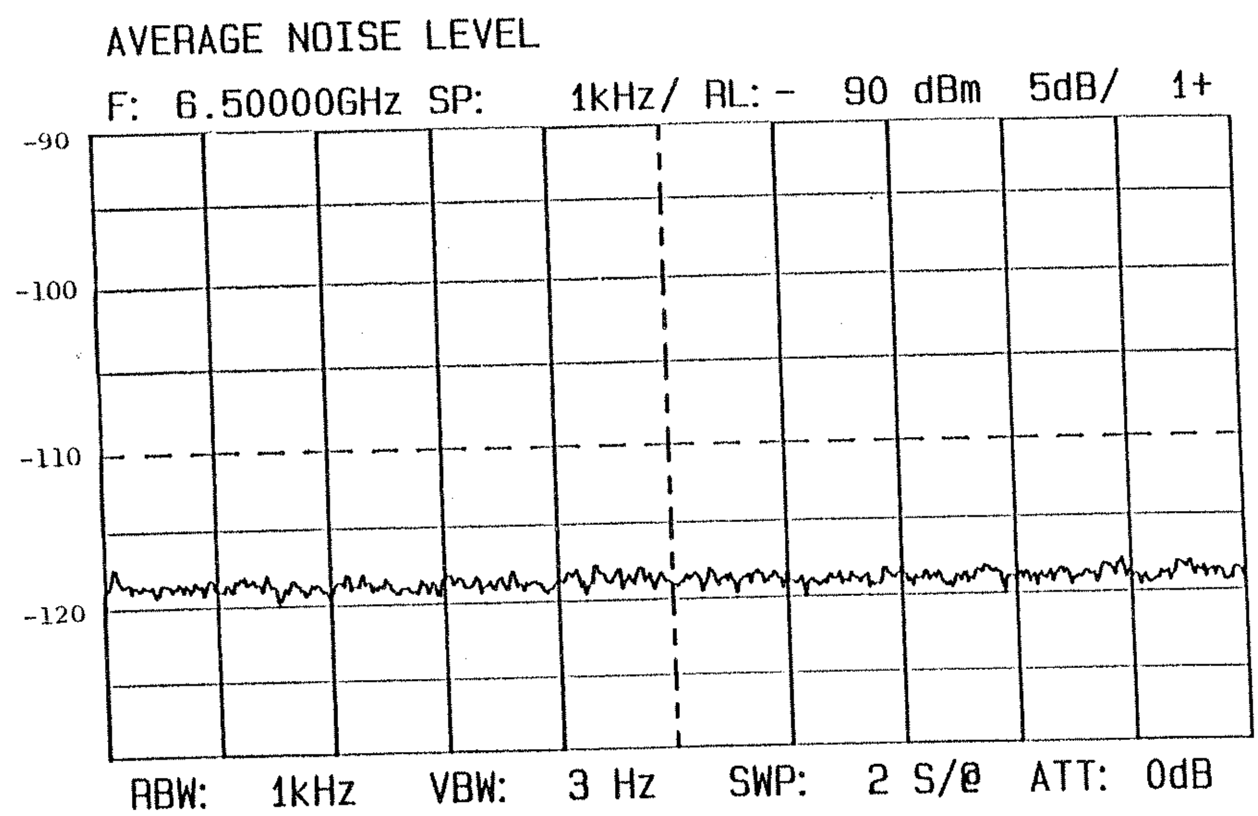



Fig. 8-35 1:7 to 23 GHz Band Average Noise Test
Sample CRT Display (2)

## 8.5 Performance Check Data Sheets

Table 8-3 CAL OUTPUT Test Data

| | Min. | | Actual Value | | Max. |
|---|---|---|---|---|---|
| Output level (dBm) | -10.30 | ≤ | ________ | ≤ | -9.70 |
| Frequency (MHz) | 99.990 | ≤ | ________ | ≤ | 100.010 |

Table 8-4 Center Frequency Readout Accuracy Test Data

| Measurement Conditions | | | Frequency Reading (MHz, GHz) | | | | |
|---|---|---|---|---|---|---|---|
| Frequency Band | Center Frequency | Frequency Span/div | Min. | | Actual Value | | Max. |
| 10 kHz to 30 MHz (MS710C only) | 15.0 MHz | 3 MHz/ | 14.3 MHz | ≤ | ________ | ≤ | 15.7 MHz |
| | 15.0 MHz | 100 kHz/ | 14.9 MHz | ≤ | ________ | ≤ | 15.1 MHz |
| | 100.0 kHz | 10 kHz/ | 67 kHz | ≤ | ________ | ≤ | 133 kHz |
| | 30.0 MHz | 100 kHz/ | 29 MHz | ≤ | ________ | ≤ | 31 MHz |
| | | | | ≤ | ________ | ≤ | |
| | | | | ≤ | ________ | ≤ | |
| 100 kHz to 2 GHz | 1000.0 MHz | 200 MHz/ | 959 MHz | ≤ | ________ | ≤ | 1041 MHz |
| | 1000.0 MHz | 100 kHz/ | 999 MHz | ≤ | ________ | ≤ | 1001 MHz |
| | 10.0 MHz | 100 kHz/ | 9 MHz | ≤ | ________ | ≤ | 11 MHz |
| | 2000.0 MHz | 100 kHz/ | 1999 MHz | ≤ | ________ | ≤ | 2001 MHz |
| | | | | ≤ | ________ | ≤ | |
| | | | | ≤ | ________ | ≤ | |

Table 8-4 (Continued)

| Measurement Conditions | | | Frequency Reading (MHz, GHz) | | |
|---|---|---|---|---|---|
| Frequency Band | Center Frequency | Frequency Span/div | Min. | Actual Value | Max. |
| 1.7 to 23 GHz | 1.700 GHz | 100 kHz/ | 1.699 GHz | ≦ ______ | ≦ 1.701 GHz |
| | 6.500 GHz | 100 kHz/ | 6.499 GHz | ≦ ______ | ≦ 6.501 GHz |
| | 12.500 GHz | 1 MHz/ | 12.4999 GHz | ≦ ______ | ≦12.5007 GHz |
| | 18.000 GHz | 1 MHz/ | 17.9997 GHz | ≦ ______ | ≦18.0003 GHz |
| | 23.000 GHz | 1 MHz/ | 22.9996 GHz | ≦ ______ | ≦23.0004 GHz |
| | | | | ≦ ______ | ≦ |
| | | | | ≦ ______ | ≦ |
| | | | | ≦ ______ | ≦ |

Table 8-5 Frequency Span Readout Accuracy Test Data

| Frequency Span/Div | Min. | Actual Value | Max. |
|---|---|---|---|
| 200 MHz/ | 190 MHz | ≦ ______ | ≦ 210 MHz |
| 100 MHz/ | 95 MHz | ≦ ______ | ≦ 105 MHz |
| 50 MHz/ | 47.5 MHz | ≦ ______ | ≦ 52.5 MHz |
| 20 MHz/ | 19 MHz | ≦ ______ | ≦ 21 MHz |
| 10 MHz/ | 9.5 MHz | ≦ ______ | ≦ 10.5 MHz |
| 5 MHz/ | 4.75 MHz | ≦ ______ | ≦ 5.25 MHz |
| 2 MHz/ | 1.9 MHz | ≦ ______ | ≦ 2.1 MHz |
| 1 MHz | 0.95 MHz | ≦ ______ | ≦ 1.05 MHz |
| 500 kHz/ | 475 kHz | ≦ ______ | ≦ 525 kHz |
| 200 kHz/ | 190 kHz | ≦ ______ | ≦ 210 kHz |
| 100 kHz/ | 95 kHz | ≦ ______ | ≦ 105 kHz |

Table 8-5 (Continued)

| Frequency Span/Div | Min. | | Actual Value | | Max. |
|---|---|---|---|---|---|
| 50 kHz | 47.5 kHz | ≤ | ________ | ≤ | 52.5 kHz |
| 20 kHz/ | 19 kHz | ≤ | ________ | ≤ | 21 kHz |
| 10 kHz/ | 9.5 kHz | ≤ | ________ | ≤ | 10.5 kHz |
| 5 kHz/ | 4.5 kHz | ≤ | ________ | ≤ | 5.5 kHz |
| 2 kHz/ | 1.8 kHz | ≤ | ________ | ≤ | 2.2 kHz |
| 1 kHz/ | 0.9 kHz | ≤ | ________ | ≤ | 1.1 kHz |

Table 8-6 START/STOP Frequency Readout Accuracy Test Data

| Set Value | | Min. | | Actual Value | | Max. |
|---|---|---|---|---|---|---|
| START: | 1.700 GHz | 0.744 GHz | ≤ | ________ | ≤ | 2.656 GHz |
| STOP: | 23.000 GHz | 22.038 GHz | ≤ | ________ | ≤ | 23.962 GHz |
| START: | 2.000 GHz | 1.750 GHz | ≤ | ________ | ≤ | 2.250 GHz |
| STOP: | 12.000 GHz | 11.750 GHz | ≤ | ________ | ≤ | 12.250 GHz |
| START: | 2.000 GHz | 1.924 GHz | ≤ | ________ | ≤ | 2.076 GHz |
| STOP: | 5.000 GHz | 4.924 GHz | ≤ | ________ | ≤ | 5.076 GHz |
| START: | | | ≤ | ________ | ≤ | |
| STOP: | | | ≤ | ________ | ≤ | |
| START: | | | ≤ | ________ | ≤ | |
| STOP: | | | ≤ | ________ | ≤ | |

## Table 8-7 Marker Frequency Accuracy Test Data

| Frequency Band | Center Frequency | Frequency Span/div | RES BW | Actual Value | Specification MS710C/E | Specification MS710D/F |
|---|---|---|---|---|---|---|
| 10 kHz to 30 MHz | 15.0 MHz | 100 kHz | 10 kHz | kHz | ±24 kHz | ——— |
| | | 3 MHz | 100 kHz | kHz | ±613 kHz | ——— |
| 100 kHz to 2 GHz | 1000.0 MHz | 100 kHz | 10 kHz | kHz | ±52 kHz | ±1.02 MHz |
| | | 200 MHz | 3 MHz | kHz | ±40.33 MHz | ±41.3 MHz |
| 1.7 to 23 GHz | 12.5 GHz | 100 kHz | 10 kHz | kHz | ±146 kHz | ±2.02 MHz |
| | | 200 MHz | 3 MHz | kHz | ±40.43 MHz | ±43.3 MHz |

## Table 8-8 Resolution Bandwidth Accuracy Test Data

| RES BW | FREQ SPAN/DIV | Resolution Bandwidth Accuracy | | |
|---|---|---|---|---|
| | | Min. | Actual Value | Max. |
| 3 MHz | 200 MHz/ | 2,400 MHz | | 3,600 MHz |
| 1 MHz | 100 MHz/ | 800 kHz | | 1,200 MHz |
| 300 kHz | 20 MHz/ | 240 kHz | | 360 kHz |
| 100 kHz | 5 MHz/ | 80 kHz | | 120 kHz |
| 30 kHz | 1 MHz/ | 24 kHz | | 36 kHz |
| 10 kHz | 200 kHz/ | 8 kHz | | 12 kHz |
| 3 kHz | 50 kHz/ | 2.4 kHz | | 3.6 kHz |
| 1 kHz | 20 kHz/ | 800 Hz | | 1.2 kHz |
| 300 Hz | 5 kHz/ | 240 Hz | | 360 Hz |
| 100 Hz | 7 kHz/ | 80 Hz | | 120 Hz |

Table 8-9 Resolution Bandwidth Selectivity Data

| Set Value (RBW) | 60 dB Bandwidth | 6 dB Bandwidth | Actual Value (60 dB BW/6 dB BW) |
|---|---|---|---|
| 3 MHz | ________ | ________ | ________ $\leqq$ 10 |
| 1 MHz | ________ | ________ | ________ $\leqq$ 10 |
| 300 kHz | ________ | ________ | ________ $\leqq$ 10 |
| 100 kHz | ________ | ________ | ________ $\leqq$ 10 |
| 30 kHz | ________ | ________ | ________ $\leqq$ 10 |
| 10 kHz | ________ | ________ | ________ $\leqq$ 10 |
| 3 kHz | ________ | ________ | ________ $\leqq$ 10 |
| 1 kHz | ________ | ________ | ________ $\leqq$ 10 |

Table 8-10 Residual FM Test Data

Residual FM: ________ $Hz_{p-p}$/0.1 s $\leqq$ 200 $Hz_{p-p}$/0.1 s

________ $Hz_{p-p}$/0.1 s $\leqq$ 100 $Hz_{p-p}$/0.1 s (10 k to 30 MHz band)

Table 8-11 Noise Sidebands Data

Noise sidebands: ________ dB $\leqq$ -75 dB

## Table 8-12 Display Linearity Test Data

1. 1 dB/div

| Scale Line No. | Input Attenuation Setting (dB) Nominal Value | Input Attenuation Setting (dB) Actual Value | Error between Steps *1 (dB) | Accumulated Error *2 (dB) |
|---|---|---|---|---|
| 0 | 0 | 0 | ____ - ____ | ____ - ____ |
| 1 | 1 | ____ | -0.2 < ____ < +0.2 | -0.2 < ____ ≤ +0.2 |
| 2 | 2 | ____ | -0.2 ≤ ____ ≤ +0.2 | -0.4 ≤ ____ ≤ +0.4 |
| 3 | 3 | ____ | -0.2 ≤ ____ ≤ +0.2 | -0.6 ≤ ____ ≤ +0.6 |
| 4 | 4 | ____ | -0.2 ≤ ____ ≤ +0.2 | -0.8 ≤ ____ ≤ +0.8 |
| 5 | 5 | ____ | -0.2 ≤ ____ ≤ +0.2 | -1.0 ≤ ____ ≤ +1.0 |
| 6 | 6 | ____ | -0.2 ≤ ____ ≤ +0.2 | -1.2 ≤ ____ ≤ +1.2 |
| 7 | 7 | ____ | -0.2 ≤ ____ ≤ +0.2 | -1.4 ≤ ____ ≤ +1.4 |
| 8 | 8 | ____ | -0.2 ≤ ____ ≤ +0.2 | -1.5 ≤ ____ ≤ +1.5 |

*1 (Actual value for scale line No. N) - (Actual value for scale line No. N-1) - 1

*2 (Actual value for scale line N) - (Nominal value for horizontal scale line N)

2. 10 dB/div

| Scale Line No. | Input Attenuation Setting (dB) Nominal Value | Input Attenuation Setting (dB) Actual Value | Error between Steps *1 (dB) | Accumulated Error *2 (dB) |
|---|---|---|---|---|
| 0 | 0 | 0 | ____ - ____ | ____ - ____ |
| 1 | 10 | ____ | -1.5 < ____ < +1.5 | -1.5 < ____ < +1.5 |
| 2 | 20 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |
| 3 | 30 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |
| 4 | 40 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |
| 5 | 50 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |
| 6 | 60 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |
| 7 | 70 | ____ | -1.5 ≤ ____ ≤ +1.5 | -1.5 ≤ ____ ≤ +1.5 |

Table 8-13 Screen Display (Log Scale) Switching Error Test Data

| VERTICAL SCALE dB/div | CAL SIGNAL LEVEL (Pr, Px) dBm | Switching Error dB | Specification dB |
|---|---|---|---|
| 1 | ________ (ref) | 0 | |
| 2 | ________ | ________ | ±1 |
| 5 | ________ | ________ | ±1 |
| 10 | ________ | ________ | ±1 |

Table 8-14 Reference Level Accuracy Test Data

| REFERENCE LEVEL (dBm) | Attenuation Nominal Value A (dB) | Attenuation Actual Value B (dB) | Reference Level Error B-A (dB) |
|---|---|---|---|
| -20 | 10 | ________ | ________ |
| -30 | 20 | ________ | ________ |
| -40 | 30 | ________ | ________ |
| -50 | 40 | ________ | ________ |
| -60 | 50 | ________ | ________ |
| -70 | 60 | ________ | ________ |
| -80 | 70 | ________ | ________ |
| -90 | 80 | ________ | ________ |
| -51 | 41 | ________ | ________ |
| -52 | 42 | ________ | ________ |
| -53 | 43 | ________ | ________ |
| -54 | 44 | ________ | ________ |
| -55 | 45 | ________ | ________ |
| -56 | 46 | ________ | ________ |
| -57 | 47 | ________ | ________ |
| -58 | 48 | ________ | ________ |
| -59 | 49 | ________ | ________ |

Table 8-15 Reference Frequency Response Test Data

| Frequency Band | Measurement Frequency | Actual Value | Specification |
|---|---|---|---|
| 100 kHz to 2 GHz | 1 MHz | ____ | ±2.5 dB |
| | 10 MHz | ____ | ±1.5 dB |
| | 1.5 GHz | ____ | ±1.5 dB |
| | 2 GHz | ____ | ±1.5 dB |
| 1.7 to 23 GHz | 1.7 GHz | ____ | ±2.5 dB |
| | 5 GHz | ____ | ±2.5 dB |
| | 6 GHz | ____ | ±3.0 dB |
| | 12 GHz | ____ | ±3.0 dB |
| | 18 GHz | ____ | ±4.0 dB |
| | 23 GHz | ____ | ±4.0 dB |

Table 8-16 Input Attenuator Accuracy Test Data

Meausrement conditions

Span Width/DIV = 1 MHz, RES BW = 100 kHz

VIDEO BW = 300 kHz

| Frequency | Measurement Attenuator | Actual Value | | Specification |
|---|---|---|---|---|
| 100 kHz to 2 GHz Band | Error between steps | | | |
| 1000 MHz | 60 dB - 50 dB | ______ | dB | ≦±1.0 dB |
| | 50 dB - 40 dB | ______ | dB | |
| | 40 dB - 30 dB | ______ | dB | |
| | 30 dB - 20 dB | ______ | dB | |
| | 20 dB - 10 dB | ______ | dB | |
| | 10 dB - 0 dB | ______ | dB | |
| | Cumulative error | | | |
| | 60 dB - 0 dB | ______ | dB | ≦±2.2 dB |
| 1.7 to 23 GHz Band | Error between steps | | | |
| 12.5 GHz | 40 dB - 30 dB | ______ | dB | ≦±2.0 dB |
| | 30 dB - 20 dB | ______ | dB | |
| | 20 dB - 10 dB | ______ | dB | |
| | 10 dB - 0 dB | ______ | dB | |
| | Cumulative error | | | |
| | 40 dB - 0 dB | ______ | dB | ≦±3.0 dB |

Table 8-17 2nd Harmonic Distortion Test Data

| Frequency Band | Center Frequency | Actual Value | Specification |
|---|---|---|---|
| 10 kHz to 30 MHz | 200 kHz | ______ dB | ≤-60 dB |
| | 10 MHz | ______ dB | ≤-70 dB |
| 100 kHz to 2 GHz | 5.0 MHz | ______ dB | ≤-60 dB |
| | 100.0 MHz | ______ dB | ≤-70 dB |
| | 500.0 MHz | ______ dB | ≤-80 dB |
| 1.7 to 23 GHz | 6.0 GHz | ______ dB | ≤-100 dB |

Table 8-18 Two Signal 3rd Order Intermodulation Distortion Test Data

| Frequency Band | Measurement Frequency F1 | F2 | F2-F1 | Actual Value | Specification |
|---|---|---|---|---|---|
| 100 kHz to 2 GHz | 1000 MHz | 1002.5 MHz | 2.5 MHz | ______ | ≤-80 dB |
| | 1000 MHz | 1000.05 MHz | 50 kHz | ______ | ≤-70 dB |
| 1.7 to 23 GHz | 7 GHz | 7.07 GHz | 70 MHz | ______ | ≤-100 dB |
| | 12.5 GHz | 12.50005 GHz | 50 kHz | ______ | ≤ -70 dB |
| 10 kHz to 30 MHz | 15 MHz | 15.05 MHz | 50 kHz | ______ | ≤-70 dB |

Table 8-19 Residual Response Test Data

Measurement conditions

Input 50 Ω terminated, ATT = 0 dB,
Frequency: 100 kHz to 6.5 GHz

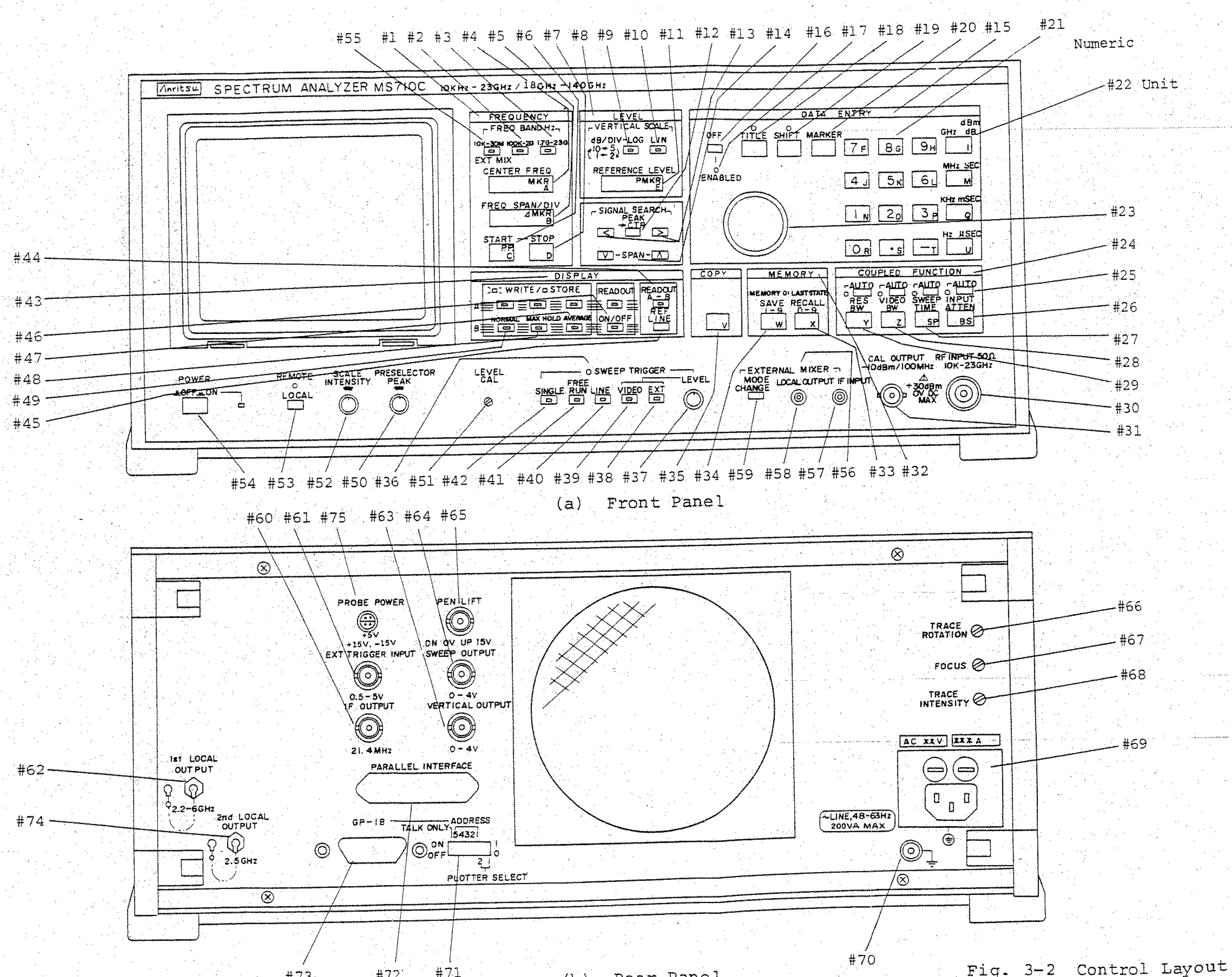
| Frequency Band | Measurement Frequency | Actual Value | Specification |
|---|---|---|---|
| 100 kHz to 2 GHz<br>Measurement Frequency<br>10 MHz or more | ________ MHz | ________ dBm | ≦ -90 dBm |
| 1.7 to 23 GHz<br>Measurement Frequency<br>6.5 GHz or less | ________ MHz | ________ dBm | ≦ -90 dBm |
| 10 kHz to 30 MHz<br>Measurement Frequency<br>100 kHz to 30 MHz | ________ MHz | ________ dBm | ≦ -90 dBm |

## Table 8-20 Average Noise Level Test Data

Measurement conditions

RES BW = 1 kHz, VIDEO BW = 3 Hz, INPUT ATTEN = 0 dB

| Frequency Band | Center Frequency | Actual Value | Specifications (dBm) |
|---|---|---|---|
| 100 kHz to 2 GHz | 100 kHz | ________ | ≤ -95 |
| | 1 MHz | ________ | ≤ -115 |
| | 2 GHz | ________ | ≤ -115 |
| 1.7 to 23 GHz | 1.7 GHz | ________ | ≤ -110 |
| | 6.5 GHz | ________ | ≤ -110 |
| | 12.5 GHz | ________ | ≤ -100 |
| | 18.5 GHz | ________ | ≤ -95 |
| | 23.0 GHz | ________ | ≤ -88 |
| 10 kHz to 30 MHz | 100 kHz | ________ | ≤ -95 |
| | 30 MHz | ________ | ≤ -115 |




(a) Front Panel

(b) Rear Panel

Fig. 3-2 Control Layout