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ADVANTEST®

ADVANTEST CORPORATION

R5372/73/P

Microwave Frequency Counter

Operation Manual

MANUAL NUMBER FOE-8324254D01

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Safety Summary

To ensure thorough understanding of all functions and to ensure efficient use of this instrument, please read the manual carefully before using. Note that Advantest bears absolutely no responsibility for the result of operations caused due to incorrect or inappropriate use of this instrument.

If the equipment is used in a manner not specified by Advantest, the protection provided by the equipment may be impaired.

- **Warning Labels**

  Warning labels are applied to Advantest products in locations where specific dangers exist. Pay careful attention to these labels during handling. Do not remove or tear these labels. If you have any questions regarding warning labels, please ask your nearest Advantest dealer. Our address and phone number are listed at the end of this manual.

  Symbols of those warning labels are shown below together with their meaning.

  DANGER: Indicates an imminently hazardous situation which will result in death or serious personal injury.

  WARNING: Indicates a potentially hazardous situation which will result in death or serious personal injury.

  CAUTION: Indicates a potentially hazardous situation which will result in personal injury or a damage to property including the product.

- **Basic Precautions**

  Please observe the following precautions to prevent fire, burn, electric shock, and personal injury.

  - Use a power cable rated for the voltage in question. Be sure however to use a power cable conforming to safety standards of your nation when using a product overseas.
  - When inserting the plug into the electrical outlet, first turn the power switch OFF and then insert the plug as far as it will go.
  - When removing the plug from the electrical outlet, first turn the power switch OFF and then pull it out by gripping the plug. Do not pull on the power cable itself. Make sure your hands are dry at this time.
  - Before turning on the power, be sure to check that the supply voltage matches the voltage requirements of the instrument.
  - Connect the power cable to a power outlet that is connected to a protected ground terminal. Grounding will be defeated if you use an extension cord which does not include a protected ground terminal.
  - Be sure to use fuses rated for the voltage in question.
  - Do not use this instrument with the case open.
  - Do not place anything on the product and do not apply excessive pressure to the product. Also, do not place flower pots or other containers containing liquid such as chemicals near this

product.

- When the product has ventilation outlets, do not stick or drop metal or easily flammable objects into the ventilation outlets.
- When using the product on a cart, fix it with belts to avoid its drop.
- When connecting the product to peripheral equipment, turn the power off.

- **Caution Symbols Used Within this Manual**

Symbols indicating items requiring caution which are used in this manual are shown below together with their meaning.

DANGER: Indicates an item where there is a danger of serious personal injury (death or serious injury).

WARNING: Indicates an item relating to personal safety or health.

CAUTION: Indicates an item relating to possible damage to the product or instrument or relating to a restriction on operation.

- **Safety Marks on the Product**

The folfowing safety marks can be found on Advantest products.

 : ATTENTION - Refer to manual.

 : Protective ground (earth) terminal.

 : DANGER - High voltage.

 : CAUTION - Risk of electric shock.

- **Replacing Parts with Limited Life**

The following parts used in the instrument are main parts with limited life.
Replace the parts listed below before their expected lifespan has expired to maintain the performance and function of the instrument.
Note that the estimated fifespan for the parts fisted below may be shortened by factors such as the environment where the instrument is stored or used, and how often the instrument is used.
The parts inside are not user-replaceable. For a part replacement, please contact the Advantest sales office for servicing.

Each product may use parts with limited life.
For more information, refer to the section in this document where the parts with limited life are described.

Main Parts with Limited Life

Part name	Life
Unit power supply	5 years
Fan motor	5 years
Electrolytic capacitor	5 years
LCD display	6 years
LCD backlight	2.5 years
Floppy disk drive	5 years
Memory backup battery	5 years

- **Hard Disk Mounted Products**

The operational warnings are listed below.

- Do not move, shock and vibrate the product while the power is turned on.
  Reading or writing data in the hard disk unit is performed with the memory disk turning at a high speed. It is a very delicate process.

- Store and operate the products under the following environmental conditions.
  An area with no sudden temperature changes.
  An area away from shock or vibrations.
  An area free from moisture, dirt, or dust.
  An area away from magnets or an instrument which generates a magnetic field.

- Make back-ups of important data.
  The data stored in the disk may become damaged if the product is mishandled. The hard disc has a limited life span which depends on the operational conditions. Note that there is no guarantee for any loss of data.

- **Precautions when Disposing of this Instrument**

When disposing of harmful substances, be sure dispose of them properly with abiding by the state-provided law.

Harmful substances: (1) PCB (polycarbon biphenyl)
(2) Mercury
(3) Ni-Cd (nickel cadmium)
(4) Other
Items possessing cyan, organic phosphorous and hexadic chromium and items which may leak cadmium or arsenic (excluding lead in solder).

Example: fluorescent tubes, batteries

Environmental Conditions

This instrument should be only be used in an area which satisfies the following conditions:

- An area free from corrosive gas
- An area away from direct sunlight
- A dust-free area
- An area free from vibrations
- Altitude of up to 2000 m

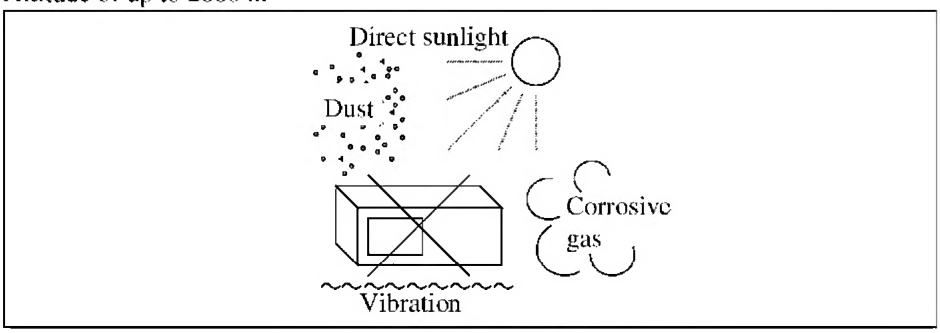


Figure-1 Environmental Conditions

- Operating position

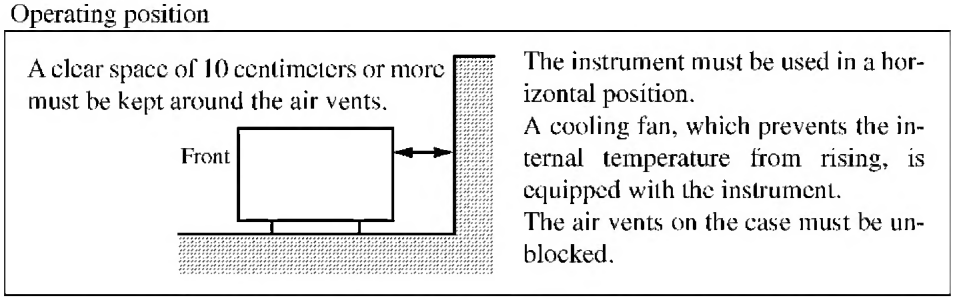


Figure-2 Operating Position

- Storage position

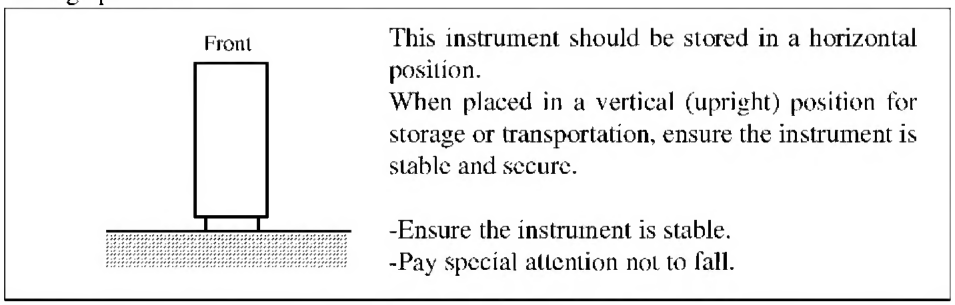


Figure-3 Storage Position

- The classification of the transient over-voltage, which exists typically in the main power supply, and the pollution degree is defined by IEC61010-1 and described below.

  Impulse withstand voltage (over-voltage) category II defined by IEC60364-4-443

  Pollution Degree 2

Types of Power Cable

Replace any references to the power cable type, according to the following table, with the appropriate power cable type for your country.

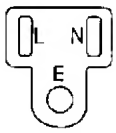
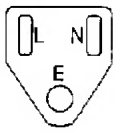
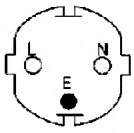
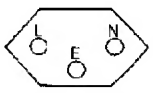
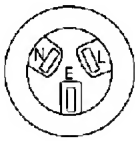
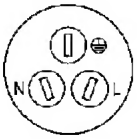
Plug configuration	Standards	Rating, color and length	Model number (Option number)
	PSE: Japan Electrical Appliance and Material Safety Law	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
	UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
	CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
	SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
	SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
	BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417
	CCC:China	250 V at 10 A Black 2 m (6 ft)	Straight: A114009 (Option 94) Angled: A114109

Table of Power Cable Options

There are six power cable options (refer to following table).

Order power cable options by Model number.

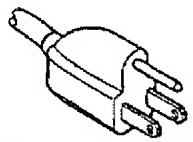
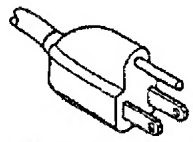
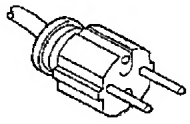
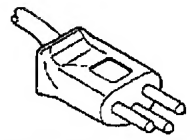
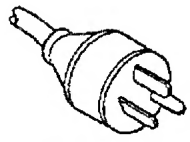
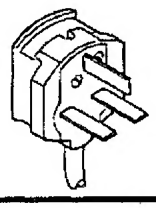
	Plug configuration	Standards	Rating, color and length	Model number (Option number)
1		JIS: Japan Law on Electrical Appliances	125 V at 7 A Black 2 m (6 ft)	Straight: A01402 Angled: A01412
2		UL: United States of America CSA: Canada	125 V at 7 A Black 2 m (6 ft)	Straight: A01403 (Option 95) Angled: A01413
3		CEE: Europe DEMKO: Denmark NEMKO: Norway VDE: Germany KEMA: The Netherlands CEBEC: Belgium OVE: Austria FIMKO: Finland SEMKO: Sweden	250 V at 6 A Gray 2 m (6 ft)	Straight: A01404 (Option 96) Angled: A01414
4		SEV: Switzerland	250 V at 6 A Gray 2 m (6 ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250 V at 6 A Gray 2 m (6 ft)	Straight: A01406 (Option 98) Angled: ---------
6		BS: United Kingdom	250 V at 6 A Black 2 m (6 ft)	Straight: A01407 (Option 99) Angled: A01417

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1. GENERAL INFORMATION

1.1 General

The R5372/5372P/5373/5373P Microwave Frequency Counter (may be referred to as the instrument in this manual) is a instrument featuring excellent cost effectiveness. It uses the digital TRAHET system developed by Advantest, combining the merits of the transfer oscillator technique and heterodyne technique, and a reciprocal system that enables low-frequency measurement with high resolution.
Specially designed to accurately measure pulse-modulated waves (for example, those transmitted by radar), it has the capabilities of a high-resolution carrier frequency measurement and pulse width measurement in addition to a repetitive frequency measuring function with high-resolution.

<FEATURES>

(1) Ultra-wide frequency coverage of 10 mHz to 18 GHz (R5372 and R5372P), 10 mHz to 27 GHz (R5373 and R5373P), and high sensitivity design.

(2) Capable of measuring burst waves.

(3) Capable of measuring microwave frequencies with 1 Hz resolution in 1 second.

(4) Capable of measuring low frequencies with high resolution by the reciprocal system.

(5) Capable of measuring pulse widths (R5372P/5373P only).

(6) Has extensive computation functions:
Frequency offset display, difference count display, frequency deviation (Δ f), parts per million (ppm), standard deviation, maximum value holding, minimum value holding, addition, subtraction, multiplication, and division

(7) Has a digital comparison function.

(8) Has a display consisting of 12 large, green LEDs representing 12 digits with a fixed point.

(9) Incorporate a high-stability crystal oscillator.

(10) Such options as the GPIB interface and the analog data output are optionally available to meet requirements for various system applications. Furthermore, the BCD data output is optionally available instead of the GPIB interface.

1.2 Preparation Before Use and General Precautions

1.2.1 Inspection

Upon receiving the instrument, unpack and check it for damage sustained in transit, paying particular attention to the switches, connectors and other knobs on the panels. If the instrument has been damaged or does not operate as specified, contact your nearest Advantest representative.

Table 1 - 1 Standard Accessories

Product	Type	Stock No.	Q'ty	Remarks
Input cable	A01036-1500	---	1	50Ω BNC cable 1.5m
	MI-04	DCB-FF0388	1	N-N
	A01002	DCB-FF1211X01	1*1	SMA-SMA *1: R5373/P only
High-frequency fuse	---	DFS-AGR125A	1	
Fuse	---	DFT-AG1R6A	2	1.6A (standard Opt32)
	---	DFT-AHR8A		0.8A (Opt42, Opt44)
Power cable	*2	*2	1	*2: See 1.2.4 (2).
Connector	---	JCS-AC014PX02-1	1	
Instruction manual	---	ER5372/73/P	1	English manual

Note: For additional orders, use the type (stock No.) for each product designation.

1.2.2 Storage

When storing the instrument for prolonged periods of time, cover it with a vinyl sheet, or put it in a corrugated cardboard box, and store it in a dry place away from direct sunlight.

1.2.3 Repacking for Transportation

When transporting the instrument, use the packing materials originally used for shipment from the factory. If they have not been saved, repack this instrument as follows:

① Wrap the instrument in a vinyl sheet.

② Put the wrapped instrument in a corrugated cardboard box having a board thickness of 5 mm or more, and fill proper cushioning material around the wrapped instrument so that the cushioning material is at least 50 mm thick on all sides.

③ Put the accessories in the corrugated cardboard box, fill cushioning material, close and seal the box, and bind it with strong strings.

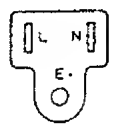
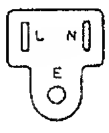
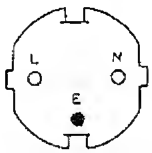
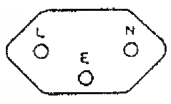
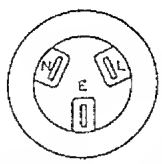
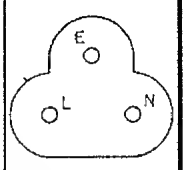
1.2.4 General Precautions Before Use

(1) Power supply

This instrument can be set for use on 100, 120, or 220 VAC ±10%, or 240 VAC $^{+4\%}_{-10\%}$ by adjusting the card inserted inside the AC LINE connector. The power frequency must be 50 or 60 Hz.
When plugging the power cable into a power outlet, make sure that the POWER switch is set to OFF.

(2) Power plugs for use outside Japan

The following power plugs are provided for each country.

Straight type	A01402 (Standard)	A01403 (Opt.95)	A01404 (Opt.96)	A01405 (Opt.97)	A01406 (Opt.98)	A01408 (Opt.99)
Angle type	A01412	A01413	A01414	A01415	-	-
Applicable Standards	JIS: Japan Law on Electrical Appliances	UL: US CSA: Canada	*1	SEV: Switzerland	SAA: Australia New Zealand	
Rating and Color	125V/7A, black, 2m	125V/7A, black, 2m	250V/6A, grey, 2m	250V/6A, grey, 2m	250V/6A, grey, 2m	250V /5A
Plug						

*1: CEE: Europe; VED: Germany; OVE: Australia; SEMKO: Sweden; DEMKO: Denmark; KEMA: Holland; FIMKO: Finland; NEMKO: Norway; CEBEC: Belgium

Figure 1 - 1 Power Plugs for Use outside Japan

(3) Fuse replacement and voltage setting

The line fuse is installed inside the AC LINE connector on the rear panel. To replace the fuse, disconnect the power cable from the AC LINE connector and slide the plastic fuse box cover located at the right of the AC LINE connector to the left. Now, the fuse can be removed by pulling the lever marked with FUSE PULL. Make sure that the replacement fuse is correct for the supply voltage. To use the instrument on a different supply voltage, change the setting of the card inserted under the fuse as follows: Remove the fuse. The card on which the voltage setting (100, 120, 220, or 240 V) is indicated appears under the FUSE PULL lever. Take out the card and insert it again in the position having the indication of the supply voltage to be used facing up on the left hand side. The voltage indication that can be read with the card inserted in position represents the value of setting. Do not forget to change the fuse with one for the newly set voltage.

Standard or Opt.32: 1.6 A slow-blow fuse
Opt.42 or Opt.44 : 0.8 A slow-blow fuse

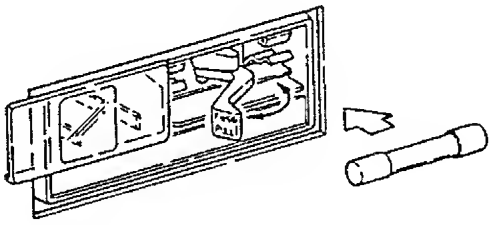


Figure 1 - 2 Fuse Replacement

(4) Time base oscillator warming

Plugging the power cable of the instrument into an AC power outlet immediately turns on the built-in crystal oscillator, the oven heater and the 10 MHz multiplier; the OVEN lamp on the front panel goes on. In this state, a 10 MHz time-base signal is output from the STD IN/OUT connector on the rear panel.

To make a highly accurate measurement, it is best to leave the power cable of the instrument plugged into the AC power outlet since the crystal oscillator requires warming up before its rated stability is reached after the oven heater is powered.

CAUTION

Even if the POWER switch is set to OFF, the instrument remains partly powered as long as its power cable is left plugged into the AC power outlet. To completely cut it off, unplug the power cable.

(5) Panel-setting memory

Even if the POWER switch is set to OFF, the settings that have been made on the panels of the unit are preserved in memory as long as the power is supplied. Even if the power cable is unplugged, the contents of the memory can be retained for about 2 weeks by the built-in Ni-Cd battery.
It takes 2 to 3 days to charge the Ni-Cd battery.

(6) Operating environment

Do not use the instrument in a dusty place or in a place exposed to direct sunlight or corrosive gases. Keep the ambient temperature 0 to +40°C and humidity at 85% rh or less.

(7) Cooling ventilation

For cooling, the instrument takes in the air through the holes provided in the top and bottom covers, and it is exhausted by a ventilator attached to the rear panel. Install the instrument where its ventilation is not obstructed.

(8) Mechanical shocks

Since the instrument incorporates a crystal oscillator, do not subject it to excessive mechanical shocks.

2. PANEL DESCRIPTION

See [Figure 2-1]. The controls on the front and rear panels are explained in the order they are numbered in [Figure 2-1].

[Front panel]

① POWER switch

Pressing this switch turns on the internal circuits of the instrument for operation; pressing it again cuts the power off. Regardless of the setting of this switch, the time-base oscillator, the 10 MHz multiplier, the oven heater, and the internal memory remain powered and the OVEN lamp stays on as long as the power cable is plugged into an AC power outlet.

② MASTER RESET switch

This switch clears all key settings and the memory contents to initialize the instrument.
Pressing this switch in the GPIB remote state sets the instrument into the local state, causing the REMOTE lamp to go off.

When the lamp within SHIFT switch is on, pressing this MASTER RESET switch carries out the self-check operation for the instrument.

③ RESET switch

This switch is used to manually reset the count value. Pressing this switch reset the display to 0 and restarts measuring. If it is pressed while the HOLD switch is on, measurement is made only once. In the totalizing mode, pressing this switch resets the display to 0 and starts totalization; totalization stops when the switch is pressed again. If totalization is started while the HOLD switch is on, the display is not reset and is totalized from the last count value.

④ SAMPLE RATE control

This control adjusts the measurement interval time. Setting this control to OFF sets the interval time to approximately 0.05 seconds; setting it to MAX sets the interval time to approximately 5 seconds. In the MANUAL and HOLD modes, this control functions as the DELAYED GATE control.

⑤ HOLD switch

Pressing this switch turns its lamp on and causes measurement to be discontinued upon completion of the current measurement operation and the display at that time to be retained.
Pressing it again switches its lamp off and resets the holding state.

⑥ RESOLUTION switches

These switches are used to step the readout resolution for measurement up or down while observing the display.

⑦ INPUT SELECT switch A

Pressing the A switch switches its lamp on and selects the INPUT A connector. The incoming frequency applied to the INPUT A connector can be measured and displayed.

⑧ INPUT SELECT switch B

Pressing the B switch switches its lamp on and selects the INPUT B connector. The incoming frequency applied to the INPUT B connector can be measured and displayed.

⑨ INPUT A connector [BNC type]

When INPUT SELECT switch A is pressed, the signal applied to this connector is selected for measurement.
The measurable frequency range is from 10 mHz to 550 MHz.
This connector has a built-in fuse for the protection of input circuit. (See paragraph 5-3. for the fuse replacement procedure.)

⑩ INPUT B connector

When INPUT SELECT switch B is pressed, the signal applied to this connector is selected for measurement.
For the R5372/5372P, this connector is of the N type with the measurable frequency range from 500 MHz to 18 GHz. For the R5373/5373P, this connector is of the SMA type, which is convertible into N type, with the measurable frequency range from 500 MHz to 27 GHz.

⑪ ATT switch

When measuring INPUT A signal over a frequency band of 10 mHz to 10 MHz, this switch is used to alternate the attenuation setting between 0 dB and 20 dB. Each time it is pressed, either the 0 dB lamp or 20 dB lamp goes on.
For measurement over a frequency band of 10 MHz to 550 MHz, this switch functions as the ANS setting switch; it alternates the ANS setting between ON and OFF, and either the ON lamp or OFF lamp goes on each time it is pressed. Normally, the ANS is set to ON.

⑫ RF ATT switch

When measuring INPUT B signal, this switch is used to alternate the attenuation setting between AUTO and 20 dB; each time it is pressed, either the AUTO lamp or 20 dB lamp goes on. Normally, the attenuation for input B is set to AUTO.

⑬ 10 mHz to 10 MHz/10 MHz to 550 MHz switch

When measuring INPUT A signal, this switch is used to select the frequency band between [10 mHz to 10 MHz] and [10 MHz to 550 MHz]. If the 10 mHz to 10 MHz band is selected, the input impedance becomes approximately 1 MΩ, and the LEVEL control becomes usable.
If the 10 to 550 MHz band is selected, the input impedance becomes approximately 50 Ω, and AC coupling is made. When either band is selected, the corresponding lamp goes on.

⑭ LEVEL control

When measuring INPUT A signal in the 10 mHz to 10 MHz band, this control is used to adjust the input trigger level in the range of approximately -1 to +1 V. Turning this control fully counterclockwise until it clicks causes the input to be AC-coupled.

⑮ Readout

This readout uses 12 large LEDs to display the measurement result. The leftmost LED displays a message which represents the computation function currently being used.

⑯ Lamps

These lamps indicate the unit markings to be read for current measurement. For measurement of input A in the 10 mHz to 10 MHz band, the upper lamp goes on indicating that the upper markings of MHz, kHz, Hz, and mHz are to be read; otherwise, the lower lamp goes on indicating that the lower markings of GHz, MHz, kHz and Hz are to be read.

⑰ READY lamp

When this lamp goes on, the instrument is ready to measure the input signal. The input signal cannot be measured when the instrument is engaged in computation or when the frequency band setting is being made in the MANUAL mode. When the necessary settings are completed, this lamp goes on and the input signal, if applied, is measured. If this lamp is off, it indicates that the necessary key settings have not been completed.

⑱ COUNTING lamp

This lamp remains on while the instrument is engaged in measurement. During measurement of INPUT A signal in the 10 to 550 MHz band, this lamp goes on and stays on for the gate time determined according to the RESOLUTION setting regardless of whether any signal is input. During measurement of INPUT A signal in the 10 mHz to 10 MHz band for which the gate is controlled by the input signal, this lamp is on triggered by the input signal.
In the totalizing mode, this lamp remains on from the start to end of totalization.
During measurement of the signal applied to INPUT B connector, this lamp does not go on until the input signal has been captured; it goes on after the capture, and remains on during opening the gate.

NOTE

1. When the gate time is very short, the COUNTING lamp stays on longer than the gate time so that its lighting is easily recognizable.

2. When the EXT GATE is selected in measurement of INPUT B signal, the COUNTING lamp goes on even if no signal is fed.

⑲ REMOTE lamp

When this lamp goes on, the settings for measurement are controlled by an external controller via the optional GPIB interface.

⑳ OVEN lamp

This lamp goes on to indicate that the crystal oscillator oven is powered. This lamp remains on even if the POWER switch is set to OFF as long as the power cable is plugged into an AC power outlet. When this lamp is on, the oven heater, the 10 MHz multiplier, and the backup power supply for memory are also powered, and the 10 MHz time base signal is output from the STD IN/OUT connector on the rear panel.

㉑ Key switches

The key switches are used to perform computation and to measure input B in the manual mode (single-band frequency measurement). (See 3-6 COMPUTATION DISPLAY.)

[Rear panel]

㉒ GND terminal

This is a ground terminal. When using a 2-prong adapter to connect the power cable to the AC power outlet, be sure to connect the ground lead from the adapter or this GND terminal to ground. (See Figure 2-1.)

㉓ AC LINE connector

The instrument is powered via this connector. A line fuse is installed inside this connector. The voltage setting for this connector can be changed. (See 1.2.4 (3) for the procedures for replacing the fuse and changing the line voltage setting.)

㉔ AUX IN/OUT connector

This connector can be used for various purposes; for example, to output the measurement result as an analog signal, to output the result of GO/NO-GO decision made by the comparator, or to measure a frequency with extra sensitivity and accuracy using a spectrum analyzer in combination with this instrument.
The connector type is Amphenol stock No. 57-40140 or equivalent.

Table 2 - 1 Functions of AUX IN/OUT Connector Pins

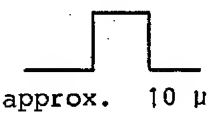
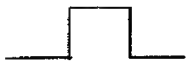
Pin No.	Signal name	Logic	Explanation
1			
2	COUNTER END	 (TTL) approx. 10 µs	Output at the measurement end.
3	EXT. RESET	 4 V to 15 V 1 µs or more	Input of external reset signal. Each time a signal is input, measurement is made once. (HOLD switch on front panel must be pressed.)
4	GATE OUT	 (TTL)	Gate signal output
5			

Table 2 - 1 Functions of AUX IN/OUT Connector Pins (Cont'd)

<table>
<tr><th>Pin No.</th><th>Signal name</th><th>Logic</th><th>Explanation</th></tr>
<tr><td>6</td><td>D/A OUT
(Only with option 01 and 02)</td><td>-4.995 V to +4.995 V</td><td>Analog output of three lowest-order digits of display after D/A conversion</td></tr>
<tr><td>7</td><td>OV (Only for unit provided with option 01/02)</td><td></td><td>Analog ground
(Used to ground D/A OUT signal)</td></tr>
<tr><td>8</td><td>INPUT SELECT D_0</td><td rowspan="4"><table><tr><th></th><th>D_0</th><th>D_1</th></tr><tr><td>[10 mHz to 10 MHz]</td><td>L</td><td>L</td></tr><tr><td>[10 MHz to 550 MHz]</td><td>L</td><td>H</td></tr><tr><td>INPUT B</td><td>H</td><td>L</td></tr></table>TTL level</td><td rowspan="2">If option 02 is provided, this signal input can be used for frequency band switching.</td></tr>
<tr><td>9</td><td>INPUT SELECT D_1</td></tr>
<tr><td>10</td><td></td><td></td></tr>
<tr><td>11</td><td>Internally detected signal</td><td>
(TTL)</td><td>Output of input signal detected according to INPUT SELECT switch setting. This pin does not function for the [10 mHz to 10 MHz] band.</td></tr>
<tr><td>12</td><td>Comparator HIGH</td><td rowspan="2">Ground signal level
(Equivalent to SN 7416)</td><td rowspan="2">If option 01/02 is provided, both outputs go high when comparators are switched off.</td></tr>
<tr><td>13</td><td>Comparator LOW</td></tr>
<tr><td>14</td><td>GND</td><td>0 V</td><td>Logic signal ground terminal</td></tr>
</table>

㉕ TRIG MODE switches

These switches are used to select the synchronization mode (EXT GATE, EXT START, INT, or LINE) to measure a pulse-modulated wave frequency or FM deviation (See paragraph 3-5 for further details.)

㉖ EXT IN connector

This connector is used to provide an external signal when the EXT GATE mode or EXT START mode is selected with the TRIG MODE switch. The external signals required are as follows:

EXT GATE : TTL level
EXT START: 2 Vp-p or more and 10 Vp-p or less with center voltage of +1.5 V

㉗ STD EXT/INT switch

This switch is used to select either the internal time-base crystal oscillator or an external time-base signal. When this switch is set to INT, the time base of the internal crystal oscillator is selected. When it is set to EXT, the instrument operates based on an external time-base signal of 1, 2, 2.5, 5, or 10 MHz.

㉘ STD ADJ

This is an adjuster for use in calibrating the crystal oscillator that generates the internal time base.

㉙ STD IN/OUT connector

When the STD EXT/INT switch is set to EXT, an external time-base signal is provided via this connector. The frequency of the external time-base signal can be 1, 2, 2.5, 5, or 10 MHz. Its amplitude must be in the range of 1 to 10 Vp-p. The input impedance is approximately 500 Ω.
When the STD EXT/INT switch is set to INT, a 10 MHz time-base signal is output; the amplitude is 1 Vp-p or more and the output impedance is approximately 50 Ω.

㉚ Ventilator

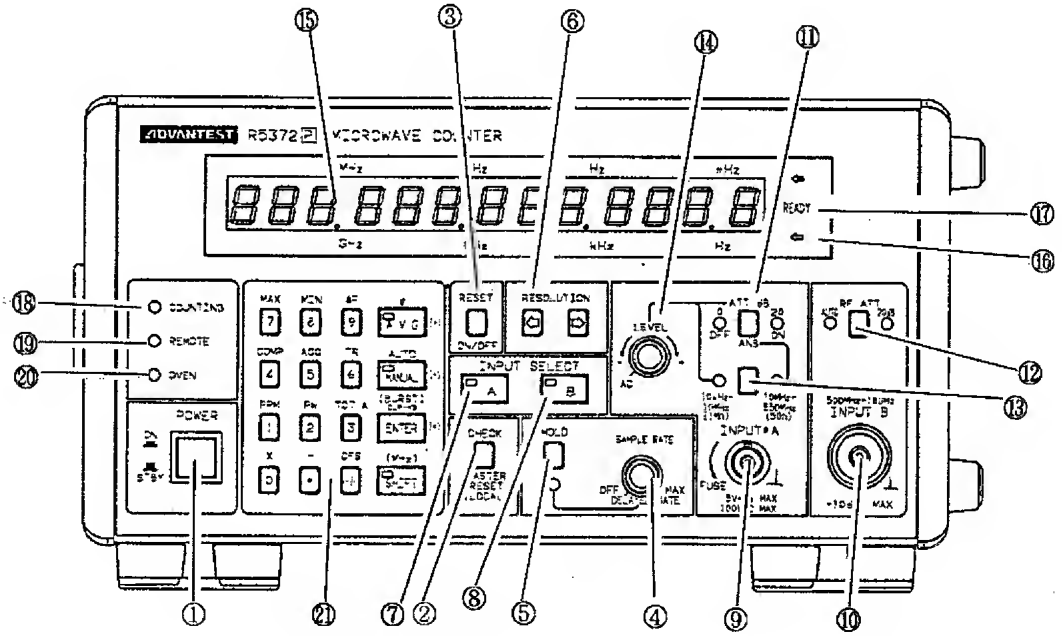
A ventilator to exhaust air is installed in the instrument to minimize internal temperature rise.

(31) ADDRESS switch

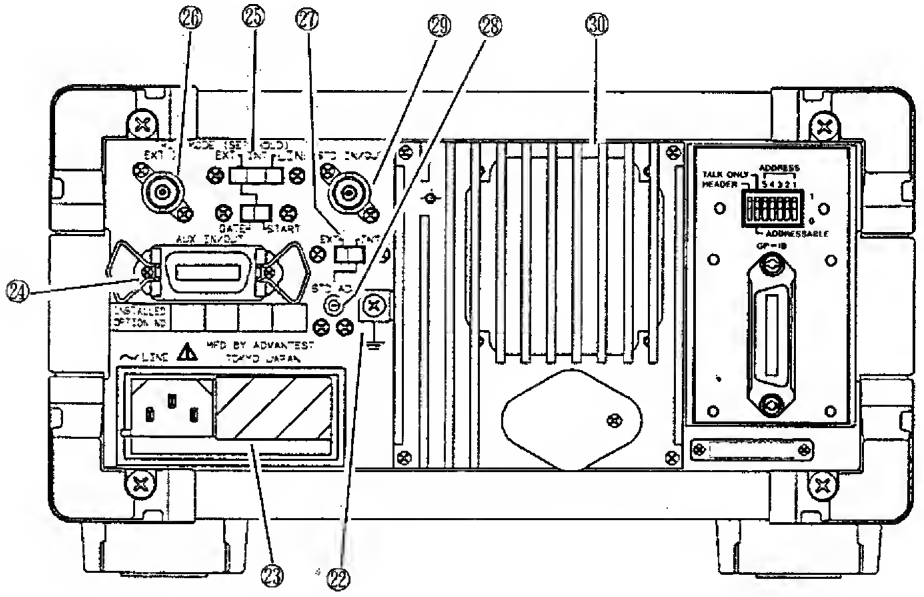
This switch is a DIP switch to specify the address (talker or listener address) on the bus. Set the first to fifth bits to the address codes. Setting the sixth bit to the ADDRESSABLE mode enables addressing to be done from the controller. Setting it to the TALK ONLY mode specifies the talker mode regardless of the ADDRESS 1 to 5 settings. Setting the seventh bit to 1 sends headers. Setting it to 0 specifies headers as space codes.

(32) GPIB connector

This connector has 24 pins and is used for bus cable connection. Since this connector is a piggy-back type, standard bus cables can be stacked together. Up to three connectors can be used.



Front Panel



Rear Panel

Figure 2 - 1 Panel Description

3. OPERATING PROCEDURE

3.1 Basic Operating Procedure

This paragraph explains the basic procedure for operating the instrument. The procedure can also be used to check whether the instrument operates correctly.

(1) First, make sure that the voltage setting made inside the AC LINE connector agrees with the available line voltage and that the POWER switch on the front panel is set to OFF. Next, connect the power cable connector to the AC LINE connector of the instrument and the plug at the other end of the power cable to an AC power outlet.

(2) When the time-base signal generated by the internal crystal oscillator is used, set the STD EXT/INT switch on the rear panel to INT; when an external time-base signal is to be used, set the switch to EXT and provide an external time-base signal to the STD IN/OUT connector.

(3) Set the POWER switch to ON; the self-check function is automatically executed causing all segments of all display digits and all LEDs except the COUNTING lamp to go on. At this time, make visual checks for all lamps.

(4) After all display digits go on, the ROM, RAM, and internal circuits of the instrument are automatically checked. If any fault is detected, the corresponding error message is displayed. (See 3-7. COMMAND/ERROR MESSAGES for the meanings of error messages.)

3.1.1 Self-performance Checks

When the instrument is in normal condition and is powered, it is initialized to the most recent settings (the settings that were valid immediately before the instrument was previously switched off) that have been stored in the memory.
When the instrument is turned on after its power cable has been unplugged for prolonged period of time, it is initialized as follows:

(1) Press the MASTER RESET switch and check that the settings have been initialized as follows:

RESOLUTION	100 Hz
INPUT SELECT	B
SAMPLE RATE	Holding state is reset.
Display	0.0 kHz READY ←
INPUT B	AUTO
Computation	OFF

(2) To check the key switches and the display, press the SHIFT switch (its lamp goes on), then the CHECK switch. (See 3-7. Error messages)

(3) Press the same key switches as mentioned in (2) above again; the display becomes as follows:



(R5372/5373)



(R5372P/5373P)

(4) Turning the SAMPLE RATE control, make sure that the blinking rate of the COUNTING lamp changes.

(5) Change the RESOLUTION switch setting and make sure that the display correspondingly changes as follows:

When the ◇ key is pressed, the number of digits of the resolution is increased by one from the currently-displayed resolution.

When the ◇ key is pressed, the number of digits of the resolution is decreased by one from the currently-displayed resolution.

- In use of R5372/73

  When the ◇ key is pressed once, the resolution is changed to 10 Hz.



- In use of R5372P/73P

  When the ◇ key is pressed once, the resolution is changed to 1 kHz.



(6) To reset the self-check mode, press the SHIFT and CHECK switches, or press INPUT SELECT switch A or B.

3.1.2 Self-checks after Recovery from power failure (Including Instantaneous One)

The instrument is set to the power on state after power recovery from service interruption. The self-checks are carried out, and the instrument then resumes the state before the power failure.

3.2 Measurement AT INPUT A

3.2.1 Measurement in 10 mHz to 10 MHz Band (Continuous Wave Signal)

(1) Press the MASTER RESET switch.

(2) Press INPUT SELECT switch [A].

(3) Select the [10 mHz to 10 MHz] band.

(4) Set the ATT switch according to the incoming signal level.

(5) Apply the unknown signal to the INPUT A connector.

CAUTION

Never apply the following damaging level to the INPUT A connector.

INPUT A at 10 mHz to 10 MHz band

5 Vrms (1 MHz to 10 MHz)

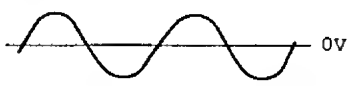
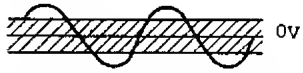
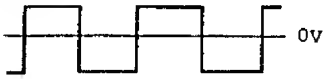
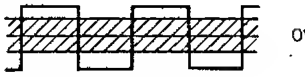
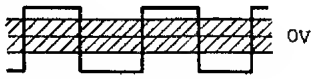
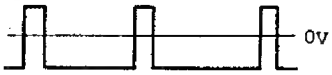
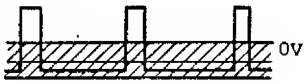
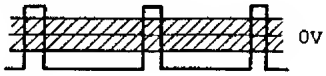
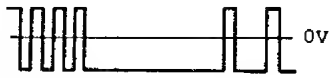
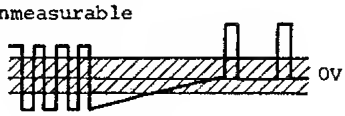
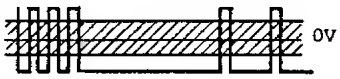
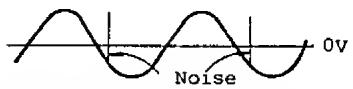
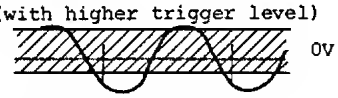
10 Vrms (400 Hz to 1 MHz)

100 Vrms (DC to 400 Hz)

(6) Turn the LEVEL control fully counterclockwise and set it to the AC position, or adjust the control to set a proper trigger level. If the trigger level is properly adjusted, the COUNTING lamp goes on and measurement starts. (See Figures 3-1 and 3-2 for adjustment of the trigger level.)

NOTE

1. For a sine-wave input signal, the range of frequencies that can be measured in the AC coupling mode is from 10 Hz to 10 MHz.
2. Even if the gate opens and the COUNTING lamp goes on, measurement is not performed while the trigger level is adjusted.

Input signal waveform	AC coupling	DC coupling Trigger level adjustment
Sine wave 	Measurable 	Measurable 
Pulse (duty factor = 50%) 	Measurable 	Measurable 
Pulse (duty factor ≠ 50%) 	Unmeasurable 	Measurable 
Random pulse 	Unmeasurable 	Measurable 
Containing noise 	Unmeasurable  Noise is counted in	Measurable (with higher trigger level) 
Containing DC component much greater than signal level 	Measurable 	Unmeasurable  Cannot be compensated for by trigger level adjustment.

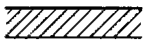
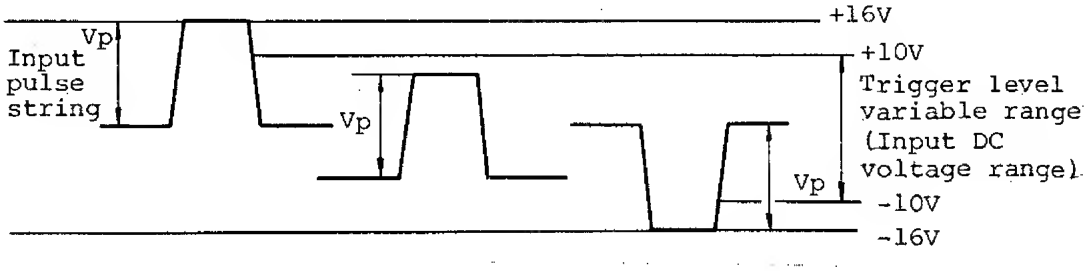
 shows hysteresis level

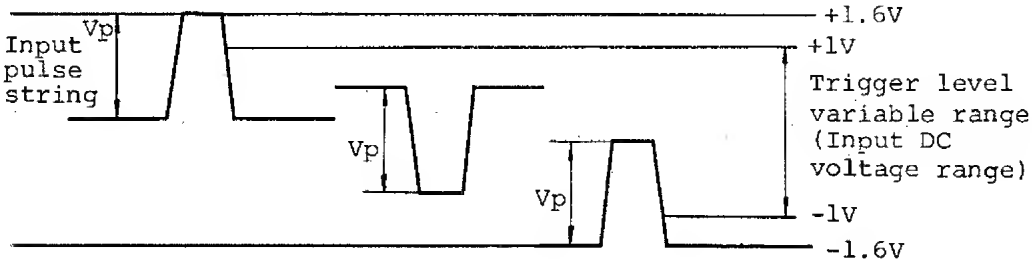
Figure 3 - 1 Setting of Input Coupling Mode

ATT 0 dB



Vp: Maximum input signal amplitude 1.4 Vp-p (Approx. 500 mVrms)

ATT 20 dB



Vp: Maximum input signal amplitude 14.0 Vp-p (Approx. 5 Vrms)

Figure 3 - 2 Relationship Between Trigger Level Variable Range and Maximum Input Signal Amplitude

(7) Set the measurement resolution using the RESOLUTION switches. Every time the ◁ switch is pressed, the resolution is lowered by one digit (the measurement time decreases); every time the ▷ switch is pressed, the resolution is raised by one digit (the measurement time increases).

(8) Adjust the measurement repetition rate as required using the SAMPLE RATE control.

3.2.2 Measurement in 10 MHz to 550 MHz Band (Continuous Wave Signal)

(1) Press the MASTER RESET switch.
(2) Press INPUT SELECT switch [A] .
(3) The 10 MHz to 550 MHz band has already been selected.
(4) Apply the unknown signal to the INPUT A connector.

CAUTION

Never apply the following damaging level voltage to the INPUT A connector.

INPUT A 10 MHz to 550 MHz band

5 Vrms

(5) Set the measurement resolution using the RESOLUTION switches. Every time the ◁ switch is pressed, the resolution is lowered by one digit (the measurement time decreases); every time the ▷ switch is pressed, the resolution is raised by one digit (the measurement time increases).

(6) Adjust the measurement repetition rate as required using the SAMPLE RATE control.

3.2.3 Totalize

(1) Press the MASTER RESET switch.
(2) Press INPUT SELECT switch [A] .
(3) Select the 10 mHz to 10 MHz band.
(4) Set the ATT switch according to the input level.
(5) Apply the input signal to the INPUT A connector.
(6) Adjust the trigger level by the LEVEL control as the input signal frequency is displayed.
(7) Press the [SHIFT] switch (its lamp goes on), then the TOT A [3] switch.
(8) Press the ON/OFF switch; the COUNTING lamp goes on and counting starts.
(9) Press the ON/OFF switch again; the COUNTING lamp goes off and the count is maintained.

(10) Next, pressing the ON/OFF switch again causes the previous count to be reset. When HOLD switch is set to on, pressing it causes totalization to be started again without resetting the previous count.
If the count exceeds the limit capacity ($10^{10}-1$), " □ " is displayed.

(11) To restore the frequency measurement mode, press the SHIFT switch (its lamp goes on) and the TOT A switch again; or press INPUT SELECT switch A or B.

3.2.4 Pulse Width Measurement (R5372P/5373P only)

(1) Press the MASTER RESET switch.
(2) Press INPUT SELECT switch A.
(3) Select the 10 mHz to 10 MHz band.
(4) Set the ATT switch according to the input level.
(5) Apply the unknown signal to the INPUT A connector.
(6) Adjust the trigger level using the LEVEL control; the input signal frequency is displayed.
(7) Press the SHIFT switch (its lamp goes on), then the PW 2 switch.
(8) To change the polarity, use the % switch. Pressing it during measurement of the positive pulse width (with command displayed as " ⌊ ") changes the polarity so that the negative pulse width is measured (with command displayed as " − "); pressing it again restores the positive pulse width measurement mode. The measurement result is always displayed in µs (fixed display) with the resolution being 10 ns.
(9) To restore the frequency measurement mode, press the SHIFT switch (its lamp goes on) and the PW 2 switch again; or press INPUT SELECT switch A or B.

3.3 Measurement AT INPUT B

3.3.1 Automatic Measurement in 500 MHz to 18 GHz (27 GHz for R5373/73P) Band (Continuous Wave Signal)

(1) Press the MASTER RESET switch.

(2) The INPUT SELECT switch B has already been on.

(3) Apply the unknown signal to the INPUT B connector.

> **CAUTION**
>
> Never apply the following damaging level to the INPUT B connector.
> +10 dBm max. for INPUT B

(4) The frequency is displayed.

(5) Set the measurement resolution using the RESOLUTION switches. Every time the ◁ switch is pressed, the resolution is lowered by one digit (the measurement time decerases); every time the ▷ switch is pressed, the resolution is raised by one digit (the measurement time increases).

(6) Adjust the measurement repetition rate as required using the SAMPLE RATE control.

3.3.2 Acquisition Time

The acquisition time is the interval from the pressing of the RESET switch in the INPUT B AUTO mode to the start of counting; it is approximately 300 ms.
When the frequency of the acquired signal drifts beyond the specified bandwidth*, another acquisition time of approximately 300 ms is required to acquire the signal again. The acquired signal is measured at the repetition rate (approx. 50 ms to 5 s) set with the SAMPLE RATE control.
*Bandwidth specification
±125 MHz [1.4 to 18 GHz (27 GHz for R5373/73P)]
±25 MHz [0.5 to 1.4 GHz]
If the input signal contains much spurious component, or if the input level is so high as to cause measurement errors, it may be necessary to measure INPUT B signal manually.

3.3.3 ACQ Reacquisition Mode

To measure an input signal whose frequency rapidly changes, use the ACQ mode in which signal acquisition is repeated. Pressing the SHIFT switch (its lamp goes on) and the ACQ 5 switch in that order causes signal acquisition to be made for every 10 measurements.

3.3.4 Manual Measurement in 500 MHz to 18 GHz (27 GHz for R5373/73P) Band

Whereas measurement in the AUTO mode requires the acquisition time explained in 3.2.2, manual measurement made by pressing the AUTO MANUAL switch (its lamp goes on) does not require any such acquisition time. When the approximate frequency (within the specified bandwidth of ±125MHz or ±25MHz) of the signal to be measured is known, the instrument may be manually set to be ready for counting. This method of manually setting input B may be helpful when measuring pulse-modulated waves, or when measurement errors are apt to occur because of much too great a spurious signal or much too high an input level.
The HOLD position establishes the burst wave measurement mode.
To manually set input B, use the following procedure:

(1) Press the MASTER RESET switch.

(2) The INPUT SELECT switch B has already been on.

(3) Pressing the AUTO MANUAL switch causes the previous setting to be displayed; it is of the initial setting (500 MHz), the frequency measured in the AUTO mode, or the manually set frequency.

(4) Manually set the desired frequency: ☐ ☐ ☐ ☐ ☐ ENTER (MHz)

It must be set in MHz in the range of 500 to 18000 (26999 for R5373/73P with the unit of MHz).
When the ENTER (MHz) switch is pressed, the manually set frequency is stored in the memory. Pressing only the ENTER (MHz) switch without entering any value causes the previous setting to be stored.
To restore the AUTO mode, press the SHIFT and MANUAL switches.

NOTE

When the lamp within the MANUAL switch flashes on and off with the READY lamp on the readout remaining off, press the MANUAL switch again; the AUTO mode is restored.

Example: Manually setting 4 GHz

MANUAL 4 0 0 0 ENTER (MHz)

With this setting, a frequency over the range of 3875 to 4125 MHz can be measured.

⑤ Apply the unknown signal to the INPUT B connector.

CAUTION

Never apply the following damaging level to the INPUT B connector.
+10 dBm max. for the INPUT B

⑥ Set the measurement resolution using the RESOLUTION switches. Every time the ◁ switch is pressed, the resolution is lowered by one digit (the measurement time decreases); every time the ▷ switch is pressed, the resolution is raised by one digit (the measurement time increases).

⑦ Adjust the measurement repetition rate as required using the SAMPLE RATE control.

3.4 Burst Wave Measurement

The R5372/5372P/5373/5373P can measure the carrier frequency of pulse-modulated wave signals, modulated pulse widths (R5372P/5373P only), and repetitive frequencies. It can operate in the trigger mode (see 3.5) or internal (INT) mode. This section explains the burst wave measurement in the internal mode.

3.4.1 Carrier Frequency Measurement of Burst Wave

(1) Set the TRIG MODE switch on the rear panel to INT.

(2) Press the MASTER RESET switch.

(3) Press INPUT SELECT switch [A] or [B].

(4) Set the HOLD switch to on. (The HOLD switch alternates between on and off; it is set to on when the lamp below it is on.)

(5) Set the SAMPLE RATE control on the front panel to OFF by turning it fully counterclockwise until it clicks.

(6) Manually set the estimated frequency (to be within the specified bandwidth*) of the unkown signal as the manual data using the keys.

*Bandwidth specification

±125 MHz [1.4 GHz to 18 GHz (27 GHz for R5373/73P)]

±25 MHz [500 MHz to 1.4 GHz]

Example: Manually setting 7 GHz. (The instrument becomes a frequency counter for a 7 GHz band.)

[MANUAL] [7] [0] [0] [0] [ENTER (MHz)]

NOTE

Input A requires no manual data to be specified. Pressing the [MANUAL] and [ENTER] switches makes the instrument ready for counting operation in the manual mode.

(7) Apply the input signal to the input connector selected with the INPUT SELECT switch using care to the input level; when a pulse-modulated wave signal is to be measured, its peak value must be lower than the damaging level of the instrument.

(8) a. R5372/5373

Set the desired resolution using the RESOLUTION switches so that pulse width - $\frac{1}{\text{resolution}}$ 400 ns.

Raising the resolution exceeding the above value will display error message. If the message is displayed, lower the resolution.

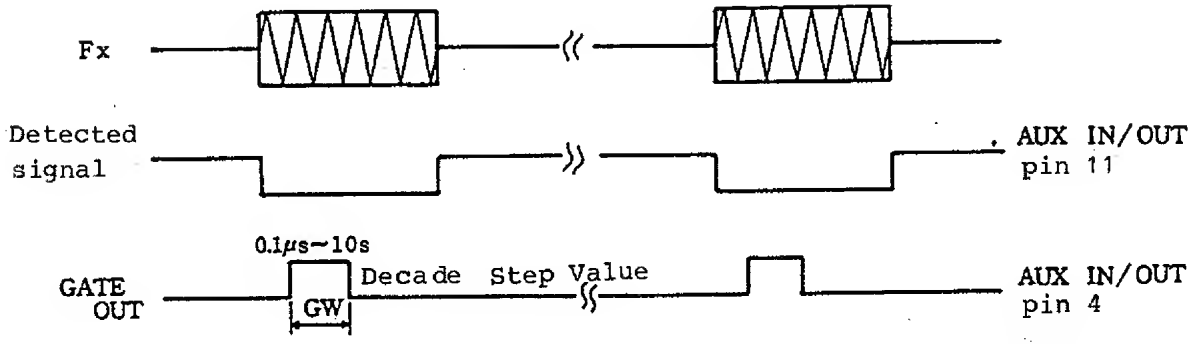


Figure 3 - 3 (a) Burst Wave Measurement on R5372/5373

b. R5372P/5373P

Set the desired resolution using the RESOLUTION switches; the average mode is automatically entered and the number of averaging measurements is automatically set according to the pulse width and the resolution, and the measurements are performed. When the resolution setting exceeds the maximum resolution determined with respect to the pulse width as shown in Figure 9-2, an error message ("Err ") is displayed, and the measurements are made with the maximum resolution shown in Figure 9-2.

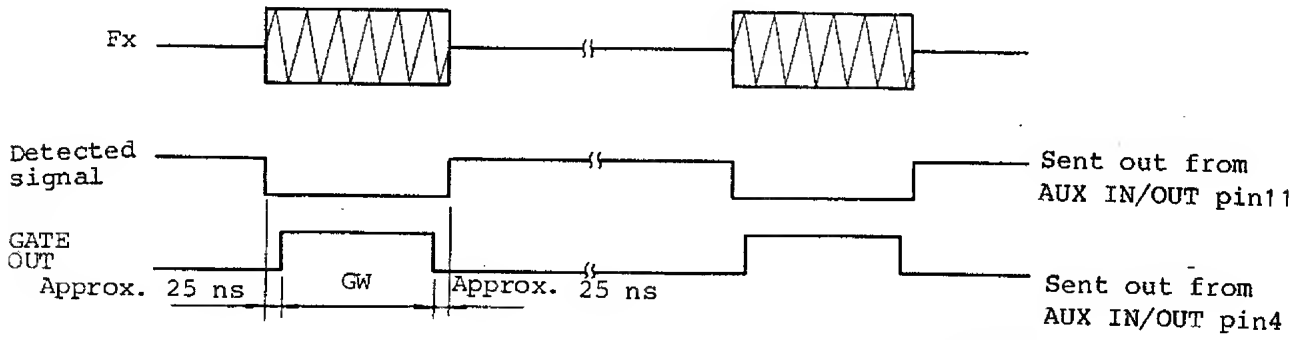


Figure 3 - 4 (b) Burst Wave Measurement on R5372P/5373P

NOTE

When the burst wave pulse width is too narrow (0.5 µs or less) or the repetitive frequency is too low, the AUTO RF ATT may not function effectively; set the RF ATT to 20 dB depending on the input level.

3.4.2 Nonstorage Mode for Burst Wave Carrier Frequency Measurement

When the number of samples is set to 1 ("n = 1 0 E 0") during burst wave carrier frequency measurement (see 3-10-10.), the current intermediate result of computation is displayed in the automatic averaging mode. In such a case, since averaging has not been completed, " - " is displayed as the command message. The result of averaging is displayed when command message " - " disappears or when a different command message appears. From that point on, the readout always displays the most recent average obtained by the moving average method (that is, smoothing mode of operation).

The restarting point of measurement can be changed by pressing the RESET switch. This is useful when one measurement for averaging requires a long time (when the pulse width is narrow and the repetitive frequency is low). The function can be set and reset by pressing the following switches:

Setting : [AVG] [0] [ENTER]

Resetting: [AVG] [AVG]

3.4.3 Modulated Pulse Width Measurement (R5372P/5373P only)

After completing the steps explained in 3.4.1, take the following steps:

(1) Press the [SHIFT] and [PW 2] switches.
(2) The result of measurement is displayed with unit of microseconds with the 10 ns resolution. Since only the pulse width portion exceeding the input sensitivity level of the instrument is measured, the measured pulse width differs according to the input level if the input signal involves long rise and fall times.

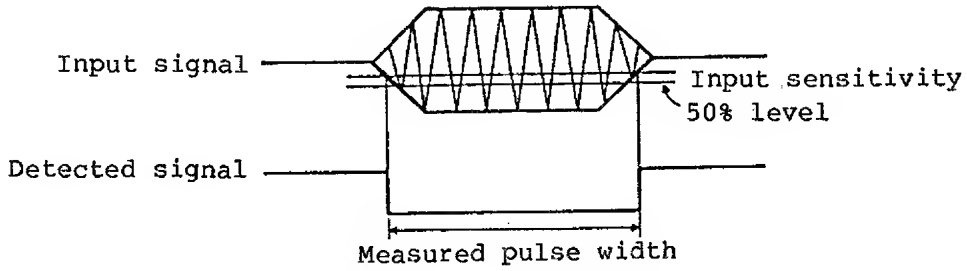


Figure 3 - 4 Modulated Pulse Width Measurement

(3) To reset the pulse width measurement mode, press the [SHIFT] and [PW 2] switches again, or press INPUT SELECT switch [A] or [B].

3.4.4 Repetitive Frequency Measurement

After completing the steps explained in 3.4.1, take the following steps:

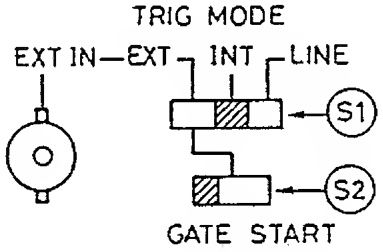
(1) Apply the detector output obtained from the AUX IN/OUT connector on the rear panel to the INPUT A connector. (Pin 11 / Pin 14 Ground)
(2) Press INPUT SELECT switch [A].
(3) Select the 10 mHz to 10 MHz band.
(4) Set the ATT switch to 20 dB.
(5) Reset the holding state.
(6) Adjust the trigger level using the LEVEl control.
(7) Set the resolution using the RESOLUTION switches. (See Figures 9-1 and 9-2 for the relationship between the measurement time and resolution.)

3.5 Synchronous Trigger Mode

3.5.1 INT/EXT/LINE Mode

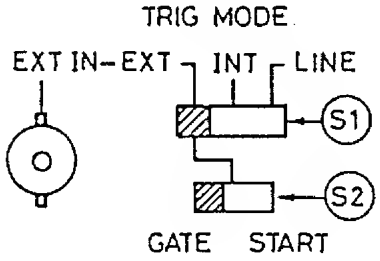
This instrument allows gate control in various modes using the TRIG MODE switches on the rear panel so that various types of measurement can be made.
These switches are useful when setting the burst wave measurement mode.

(1) INT



When measuring burst waves in the normal automatic synchronization mode, set TRIG MODE switch S1 on the rear panel to INT, since no external synchronization signal is required; S2 may be set to either GATE or START. With these settings made, the gate is cotrolled by the internally detected signal, and the gate time for R5372P/5373P is approximately 50 ns shorter than the length of the internally detected signal. Since the gate opens on the leading edge, note that a continuous-wave input signal cannot open the gate.

(2) EXT GATE



Set TRIG MODE switches S1 and S2 on the rear panel to EXT and GATE respectively, and input a 50 ns (0.5 µs for R5372/5373) or longer gate signal to the EXT IN connector. With these settings made, the gate opens when the signal input to the EXT IN connector goes low and stays open as long as the signal stays low. In this mode, the gate is opened by the signal input to the EXT IN connector regardless of whether the unknown signal is input. Figure 3-5 shows the signals output to the AUX IN/OUT connector. Each of these signals has an internal delay difference, and the gate signal is output approximately 50-100 ns later than detection signal.

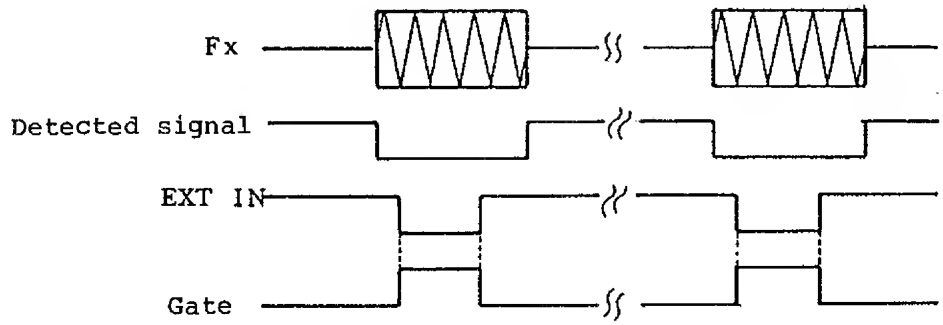
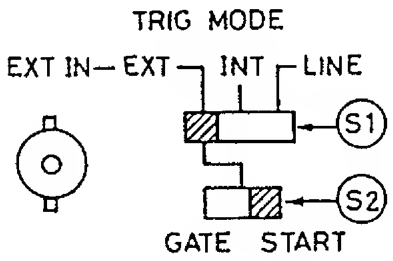


Figure 3 - 5 EXT GATE Mode

(3) EXT START



Set TRIG MODE switches S1 and S2 on the rear panel to EXT and START respectively, and input a 1 µs or longer trigger signal to the EXT IN connector. With these settings made, the gate opens when the signal input to the EXT IN connector goes low and closes when the internally detected signal goes high. Note that the trigger signal is effective only while the internally detected signal is on (low).

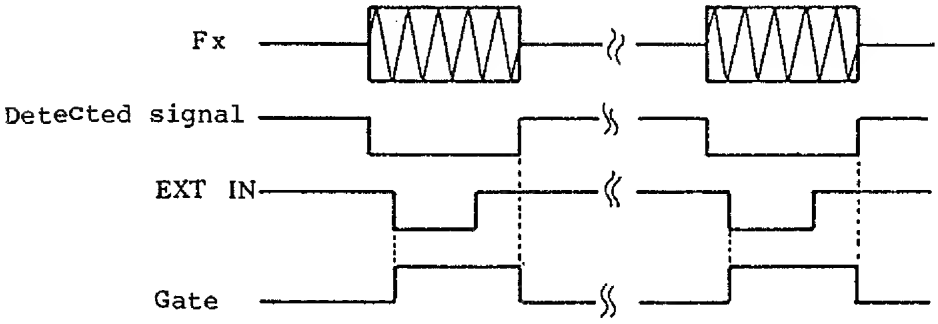
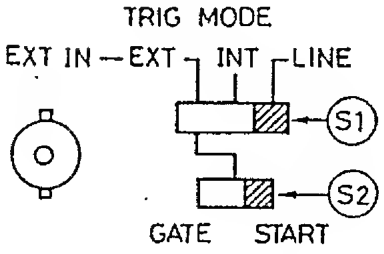


Figure 3 - 6 EXT START Mode

(4) LINE



Set TRIG MODE switch S1 to LINE; S2 may be set to either GATE or START. With these settings made, the gate opens in synchronism with the AC line frequency. Note, however, that triggering cannot be made when the internally detected signal is off (high).

NOTE

In any mode, if the time equal to the inverse of the resolution set on the front panel is shorter than the internally detected signal (external gate signal), the gate closes upon lapse of the time equal to the inverse value.

3.5.2 DELAYED GATE Mode

(1) When the DELAYED GATE control on the front panel is turned counterclockwise to OFF, the gate is opened by each trigger signal without any delay in any of the foregoing four trigger modes.

(2) The detection of each trigger signal in any of the foregoing four trigger modes can be delayed by 25 µs to 30 ms by adjusting the DELAYED GATE control.

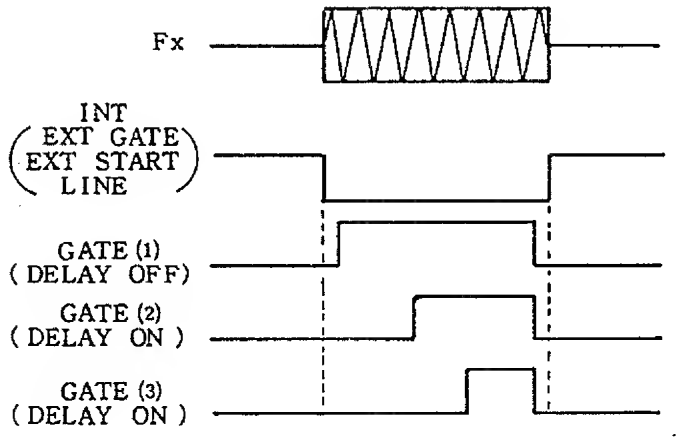


Figure 3 - 7 DELAYED GATE Mode

3.6 Computation Display (KEYBOARD OPERATION)

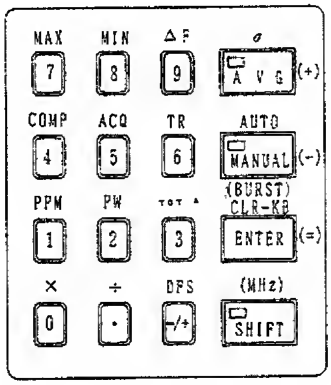
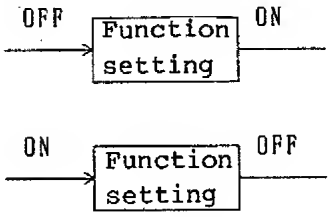


Figure 3 - 8 Key Switch Section

3.6.1 Algorithm for Setting and Resetting Computation Functions

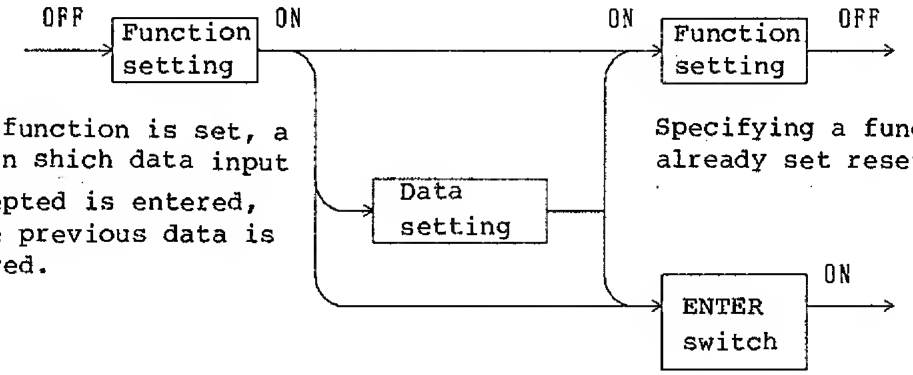
(1) Functions requiring no data setting



Specifying a function which is off sets it on.

Specifying a function which is on sets it off.

(2) Functions requiring data setting

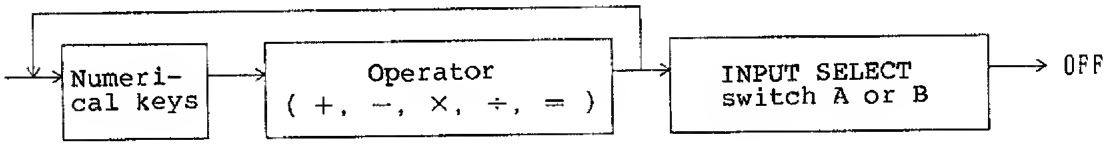


When a function is set, a state in shich data input is accepted is entered, and the previous data is displayed.

Specifying a function already set resets it.

Pressing the ENTER switch starts execution of the function using the newly input data, or the previous data if no new data has been input.

(3) Calculator function
Arithmetic operations each involving two operands of up to eight digits each can be made, like with a general electronic calculator, by pressing a numerical key to initiate each operation.



The operators are represented by the following keys:

AVG (+) MANUAL (−) ENTER (=) SHIFT × 0 SHIFT + . SHIFT CLR-KS ENTER

To reset the calculator function mode, press INPUT SELECT switch A or B .

Example: 144.48 x 3

Press the following keys:

1 4 4 . 4 8 SHIFT × 0 3 ENTER (=)

The answer is displayed as follows:

" 4 3 3 . 4 4 "

Finally, press INPUT SELECT switch A or B to reset the calculator function mode.

3.6.2 Offset Display (OFS)

It is possible to display the measurement of input A or B after adding or subtracting a certain constant value to or from measured value.

(1) Setting offset data

The offset data in MHz order may be set ranging over all digits, but its portion lower than the resolution is not displayed. With INPUT A [10 mHz to 10 MHz], frequencies are given in kHz.

Example 1: Inputting 1234 MHz as offset data

SHIFT OFS 1 2 3 4 ENTER

Example 2: Inputting -50 kHz as offset data

SHIFT OFS 4 0 . 0 5 ENTER

(2) Monitoring and changing offset data

During measurement involving offset data, the offset data can be displayed for checking by pressing the SHIFT and OFS switches. If the displayed offset data need not be changed, simply press the ENTER switch. If it is to be changed, input new offset data using numerical keys, then press the ENTER switch. At that time, if the operator(+ or -) of offset data is also to be changed, press the ± switch before inputting the new data.

(3) Discontinuing offset computation

To stop offsetting capabilities, press the SHIFT OFS SHIFT and OFS switches. Even if offsetting capabilities is discontinued, the offset data remains in the memory so that offsetting can be resumed using the same offset data by pressing the SHIFT OFS and ENTER switches.

(4) Clearing offset data

If erroneous offset data is input, clear it by pressing the SHIFT and CLR-KS ENTER switches, then input the correct data to continue operation.

3.6.3 Display of Computation between Measurements Between Two Inputs A and B

(1) It is possible to alternately measure the frequencies of inputs A and B and display the sum of, or difference between, the two measurements. (The same procedure is applicable between two inputs A or B.)

Example: Displaying the sum of measured data on inputs A and B.

① Press INPUT SELECT switch A .

② Press the SHIFT and OFS switches; the previously input offset data, if any, is displayed.

③ Press INPUT SELECT switch B ; the readout displays "b counter".

④ Press the [ENTER] switch; the measured value of input B is set as the offset data, and the sum of the measured values of inputs A and B is displayed. The polarity may be specified after pressing the [B] switch.

If no signal is input to the INPUT B connector, no value is displayed.

Table 3-1 Outlines some key operation samples.

Table 3 - 1 Key Operation Samples for Computation Between Measurements of Inputs A and B

Computation	Key operation
A - B	[A] [SHIFT] [OFS] [B] [/] [ENTER]
B + A	[B] [SHIFT] [OFS] [A] [ENTER]
B - A	[B] [SHIFT] [OFS] [A] [/] [ENTER]
A + A	[A] [SHIFT] [OFS] [A] [ENTER]

To discontinue offsetting operation, press the [SHIFT] [OFS] [SHIFT] and [OFS] switches.

NOTE

The previously set polarity remains the same until it is changed. When changing the offset data, always check the set polarity .

(2) The measured value of input A, B, or C can be used as the offset data.

Example: Observing the frequency drift of input A.

① Press INPUT SELECT switch [A].

② Press the [SHIFT] and [OFS] switches; the offset data, if any, is displayed, but it is not set.

③ Press the [SHIFT] and [A] switches; the offset data is set. At this time, the measured value obtained immediately before the [SHIFT] and [OFS] switches were pressed is displayed as the offset data.

④ Press the [OFS] and [ENTER] switches; the value of [(measured value of input A) - (Initial value of inputA)] is displayed.

To discontinue the offsetting operation, press the [SHIFT] [OFS] [SHIFT] and [OFS] switches.

To set the measured value of input B as the offset data, press the [B] switch instead of the [A] switch in step ①, and the [SHIFT] and [B] switches instead of the [SHIFT] and [A] switches in step ③.

The same procedures described above can be applied when using the measured value of input C. In this case, make sure that the lamp indicating the input C measuring frequency range is in appropriate position in step ②.

(3) The computations explained in 3.6.2 (1) to (3) and 3.6.3. (1), (2) can be made simultaneously.

Display value = (measurement of input A or B) ± (measurement of input B or A) ± (initial value of input A or B) ± K (offset data)

Example: Displaying the value of (measured value of input B + measured value of input A - initial value of input B - 30 MHz).

① Press INPUT SELECT switch [B]. (Measuring initial value of input B.)

② Press the following keys successively:

[SHIFT] [OFS] [A] [ENTER]

[SHIFT] [OFS] [SHIFT] [B] [OFS] [ENTER]

[SHIFT] [OFS] [OFS] [3] [0] [ENTER]

To stop the offsetting operation, press the [SHIFT] [OFS] [SHIFT] and [OFS] switches. In this case, settings for the offsetting operation are reset altogether; they cannot be individually reset.

3.6.4 Quotient Display (÷)

It is possible to divide the measured value of input A or B by a constant and display the quotient.

Example: Dividing the measured value of input B by 125 and displaying the quotient.

① Press INPUT SELECT switch [B] .
② Press the [SHIFT] and [÷ .] switches; the previous data is displayed.
③ Press the [1] [2] [5] and [ENTER] switches; the quotient obtained by dividing the measured value of input B by 125 is displayed.

To stop the division, press the [SHIFT] [÷ .] [SHIFT] and [÷ .] switches. The divisor must be in the range of 0.001 to 99999.999.

3.6.5 Product Display (x)

It is possible to multiply the measured value of input A, B, or C by a constant and display the product.

Example: Multiplying the measured value of input A by 18 and displaying the product.

① Press INPUT SELECT switch [A] .
② Press the [SHIFT] and [x 0] switches; the previous data is displayed.
③ Press the [1] [8] and [ENTER] switches; the product obtained by multiplying the measured value of input A by 18 is displayed.

To discontinue the multiplication, press the [SHIFT] [x 0] [SHIFT] and [x 0] switches.
The multiplier must be in the range of 0.001 to 99999.999.

3.6.6 Scaling Display

Scaling computation can be made using the offset display function and the quotient display function in combination.

$$\text{Scaling} = \frac{Fx \pm K}{D}$$

Where:

Fx = Measured value of input A or B

K = Constant

D = Constant

To use this function, proceed as follows:

(1) Input ±K using the offset computation function:

SHIFT OPS (7/4) ±K ENTER

(2) Input D using the division function:

SHIFT (÷) D ENTER

Thus, the scaling display mode has been achieved. To discontinue the scaling display operation, press the following keys:

SHIFT OPS (7/4) SHIFT OPS (7/4) (The offsetting function is reset.)

SHIFT (÷) SHIFT (÷) (The division function is reset.)

3.6.7 Parts Per Million (ppm) Display

The deviation in ppm of the measured value of input A or B from the reference value can be displayed.

Example 1: Displaying the deviation in ppm of input B with respect to 10 GHz.

(1) Press INPUT SELECT switch B.

(2) Press the SHIFT and 1 switches; the previous reference data is displayed.

(3) Press the 1 0 0 0 0 and ENTER switches; the value of the following is displayed:

$$\frac{\text{(Measured value of input B - reference value)}}{\text{Reference value}} \times 10^6$$

Example 2: Displaying the deviation in ppm with respect to a measurement of input B.

(1) Press the SHIFT 1 SHIFT B and ENTER switches.

To stop the PPM display, press the SHIFT 1 SHIFT and 1 switches.

3.6.8 Comparator Function (COMP)

It is possible to check whether the measured value of a signal is between the two levels by setting a pair of high and low levels. The level setting data may range over all digits, and the plus or minus sign can also be set.

The check result is displayed as follows:

Measurement > high level : " H " (LSD)
High level ≧ measurement ≧ low level: No display
Measurement < low level : " L " (LSD)

Example: Checking the measurement by setting the high and low levels to 11 MHz and 9 MHz respectively.

① Press the [SHIFT] and [4] switches; the previous high level is displayed together with command message " H " that is displayed at MSD.

② Press the [1] [1] and [ENTER] switches; the new high level is set, and the previous low level is displayed together with command message " L " that is displayed at MSD.

③ Press the [9] and [ENTER] switches; the comparison levels are set. At the same time, if option 01 or 02 has been installed, the HIGH signal (pin 12) and LOW signal (pin 13) are sent out from the AUX IN/OUT connector on the rear panel.

To reset the comparator function, press the [SHIFT] [4] [SHIFT] and [4] switches.

3.6.9 Maximum Value (MAX), Minimum Value (MIN), and Fluctuation Width (ΔF) Display

The maximum and minimum measurements and the fluctuation width (maximum - minimum) can be displayed. The number of samples to be taken to display such values can also be specified by using statistical computation switch [AVG] together with the [MAX 7], [MIN 8], or [ΔF 9] switch. If the number of samples is not specified, the lamp within [AVG] switch remains off; in that state, the instrument always displays the up-to-date maximum, minimum, or fluctuation value detected at or after a specified point of time.

(1) MAX display

Press the [SHIFT] and [MAX 7] switches; the instrument starts displaying the up-to-date maximum measurement. The starting point of this function can be reset by pressing the [RESET] switch; the maximum measurement detection and display are newly started when the switch is pressed.

(2) Changing MAX display to MIN or ΔF display

Pressing the [SHIFT] and [MIN 8] switches changes the MAX display to the MIN display, and pressing the [SHIFT] and [ΔF 9] switches changes the MIN display to the F display. Such display changes do not change the function starting point so that any of the maximum measurement, minimum measurement, and fluctuation width detected at or after a certain time can be displayed just by properly changing the key switch setting.

To reset the function starting point, press the [RESET] switch. To discontinue the display, check the command message display and set the same function again.

Command message;

MAX display:

MIN display:

ΔF display :

3.6.10 Statistical Computation

It is possible to display the average value, maximum value, minimum value fluctuation width, or standard deviation computed using the specified number of samples

(1) Settings

Press the [AVG] switch; the following is displayed:

"n = 1 0 E 2 0.1.2.3.4."

In the above display, " n " represents the number of samples to be taken and " E " the exponential display designation. Select

" 0 1 2 3 4 " as the exponent, then specify the number of samples to be taken. To set 1000 as the number, for example, press the [3] and [ENTER] switches.

The setting causes the average value of 1000 samples to be computed. To display a value other than the average, set the corresponding function. To display the maximum measurement, for example, press the [SHIFT] and [MAX 7] switches; it is displayed after completion of measurements of specified samples. When such a display function change is made after all samples are measured in the holding state, the computed value is displayed immediately.

To display the minimum measurement, press the [SHIFT] and [MIN 8] switches; to display the fluctuation width, press the [SHIFT] and [ΔF 9] switches; to display the standard deviation, press the [SHIFT] and [σ AVG] switches; to return to the average display, press the [SHIFT] and [σ AVG] switches. Changing one display function to another does not reset the setting of the number of samples; to reset it, press the [RESET] switch.

To discontinue the statistical computation, press the [AVG] and [AVG] switches.

(2) Number of samples

a. Setting " 0 "

Setting 0 causes a special mode to be entered. In that mode, when the automatic averaging mode is set during measurement of a pulse-modulated carrier frequency (R5372P/5373P), the current intermediate result of averaging is displayed. Command message " _ " is displayed until completion of averaging. When the final average value is displayed, the command message disappears or a different command message is displayed.

For measurement of a signal other than a pulse-modulated wave, setting " 0 " causes the number of samples to be specified as 1 so that measurement is carried out in normal mode.

b. Setting " 1 "
The number of samples is specified as 10.

c. Setting " 2 "
The number of samples is specified as 100.

d. Setting " 3 "
The number of samples is specified as 1000.

e. Setting " 4 "
The number of samples is specified as 10000.

(3) Command messages

Table 3 - 2 Command Messages Displayed During Statistical Computation

Key setting	Command message	
	MSD	LSD
AVG 2 ENTER		A
SHIFT MAX 7	n	A
SHIFT MIN 8	U	A
SHIFT ΔF 9	d	A
SHIFT σ AVG	5	A

(4) Statistical computation examples
Measuring 100 samples, and displaying the average value, the maximum value, the minimum value, the fluctuation width, and the standard deviation.

① Press the AVG 2 and ENTER switches; the number of samples is specified as 100.

② Press the HOLD switch; when the specified number of samples are measured, the holding state is entered and the average value is displayed.

③ Press the SHIFT and MAX 7 switches; the maximum value is displayed.

④ Press the SHIFT and MIN 8 switches; the minimum value is displayed.

⑤ Press the SHIFT and Δ F 9 switches; the fluctuation width is displayed.

⑥ Press the SHIFT and σ AVG switches; the standard deviation is displayed.

NOTE

1. The holding state cannot be set in the burst wave measurement mode.
2. In the burst wave measurement mode, the computed data extends down to the digits that may be lower-ordered than LSD to be displayed, so the displayed value is subject to an error of ±1 count.

(5) Total time required for statistical computation

The computation to be made to process each sample requires approximately 30 ms. The total time required is therefore given as follows:

Total time = (time needed for each measurement) x (number of samples) + 0.03 x (number of samples) (second)

If the time needed for each measurement is 100 ms and the number of samples (continuous wave signal) to be measured (with the resolution being 10 Hz) is 100, the total time required can be calculated as follows:

Total time = 0.1 x 100 + 0.03 x 100 = 13 sec.

(6) Operational expressions

After completion of each measurement, the following data is stored:

$A = Tx1$

$B = MAX\ (Txi - Tx1)$

$C = MAX\ (Tx1 - TXi)$

$$D = \sum_{i=2}^{K} (Txi - Tx1)$$

$$E = \sum_{i=2}^{K} (Txi - Tx1)^2$$

Where: Tx1 = Initial value

i = ith sample

K = Total number of samples

When the specified number of sample measurements are completed, the following computations are made, and the selected result is displayed.

Average value (AVG) = $A + \frac{D}{K}$

Maximum value (MAX) = A + B

Minimum value (MIN) = A - C

Fluctuation width (ΔF) = B + C

Standard deviation (σ) = $\sqrt{\frac{1}{K-1}(E - \frac{D^2}{K})}$

3.6.11 Transitional Difference Display

It is possible to subtract the previous measurement from the current measurement and display the difference.

Display = Txi - Tx (i - 1)
(Tx represents measured data, and i indicates the sample count.)

This function is useful for observing the short term stability of an oscillator.

To set this function, press the SHIFT and RESET switches; to reset it, press the SHIFT and RESET switches again.

3.6.12 Checking Function

(1) Self-check function

This function is automatically executed when the instrument is initially powered. When an error is detected, the corresponding error message is displayed. (See 3-7 for the error messages).

(2) Key switch and display checks

The key switch and display checks can be made using the SHIFT and CHECK switches. Press each key switch to be tested after the SHIFT and CHECK switches, and make sure that all LEDs (except the COUNTING lamp and OVEN lamp) flash on and off and that the corresponding display as shown in Table 3-3 also flashes on and off on every digit; the COUNTING lamp remains off and the OVEN lamp remains on.

(3) Counting operation check

Pressing the SHIFT and CHECK switches again starts the counting operation check routine; the readout displays "100.000.0". (See 3.1.1 for details.)

To reset the checking function, press the SHIFT and CHECK switches again, or press the INPUT SELECT switch A or B.

NOTE

Setting the checking function initializes the instrument by resetting all existing settings; the instrument then enters the state for checking.

Table 3 - 3 Correspondence between key switches and displays

Key switch	Display (all digits)	Key switch	Display (all digits)	Key switch	Display (all digits)
0	0	8	8	◇	H
1	1	9	9	◇	L
2	2	.	A	A	P
3	3	+/-	b	B	1
4	4	ENTER	C	HOLD	r
5	5	MANUAL	d	ATT dB ANS	-
6	6	AVG	E	10mHz ~ 10MHz (1MΩ) / 10MHz~550MHz (50Ω)	0
7	7	RESET	'blank'	RF ATT	.

3.7 Command/Error Messages

3.7.1 Command Messages Displayed at MSD of Readout

(1) Command messages displayed during measurement

Message	Meaning
E	Error (for example, division by 0)
O	Overload (exceeding computational capacity)
=	Burst wave averaging is being made.
P	Positive pulse width measurement is in progress.
-	Negative pulse width measurement is being made or result of measurement is negative.
t	Totalization is being made. (TOT A)
.	Offset, product, quotient, or transitional difference display
C	Comparison display (COMP)
P	Parts-per-million display (PPM)
σ	Standard deviation display (σ)
d	Fluctuation width display (ΔF)
U	Minimum value display (MIN)
n	Maximum value display (MAX)

NOTE

When two or more functions are set, the one given the highest priority among the corresponding messages (the messages listed in the above table are given priority in the order listed) is displayed, and the rest is represented by . (period).

(2) Command messages displayed during function setting (during data input)

Message	Meaning
.	Setting for offsetting is being made.
r	Setting for division is being made.
H	Setting for multiplication is being made.
P	Setting for PPM display is being made.
H	Setting for comparison display (COMP) is being made. (High level is being set.)
L	Setting for comparison display (COMP) is being made. (Low level is being set.)
-	Negative polarity

3.7.2 Command Messages Displayed at LSD of Readout

Message	Meaning
H	Measurement is higher than the high level set for comparison display function (COMP).
L	Measurement is lower than the low level set for comparison display function (COMP).
µ	Pulse width measurement unit (µs)
A	Statistical computation function has been set.

NOTE

When LSD is assigned to display 0.1 Hz, command message " " is displayed.

3.7.3 Command Messages Displayed in Main Part of Readout

(1) "n = 10E2 01234"

This message is displayed when the statistical computation function is set; the operator must specify the number of samples to be taken by selecting an exponent from 0 to 4.

(2) "dAtA Err Lo"

This message is displayed when keyed-in data is lower than required.

(3) "dAtA Err Hi"

This message is displayed when keyed-in data is higher than required.

(4) "End OF UP"

This message is displayed when the maximum resolution has been reached during resolution setting making it impossible to further raise the resolution.

(5) "End OF down"

This message is displayed when the minimum resolution has been reached during resolution setting making it impossible to further lower the resolution.

(6) "OFF SEt dAtA"

This nessage is displayed if no previous memory data is available when offset data is set.

(7) "CP dAtA Err"

This message is displayed when a comparison data input error is detected; for example, when the high level is set to be lower than the low level. If this message is displayed, correct the error.

(8) "A countEr"

This message is displayed when the measured value of INPUT A is to be used as the offset data.

(9) "b countEr"

This message is displayed when the measured value of INPUT B is to be used as the offset data.

(10) "diSPLAy"

This message is displayed when the switch and display checking program is being executed. Pressing a key switch while this message is displayed causes the corresponding display to be displayed on all digits.

(11) "PUSH Error"

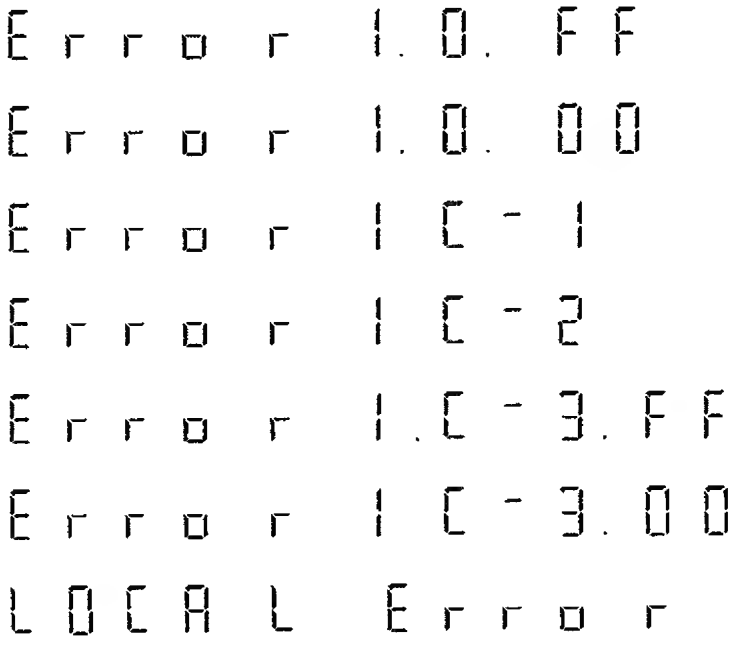
This message is displayed when a key switch is pressed in an undefined order. Such an erroneous keying is ignored, and the next keying is awaited.

(12) "ConnEction"

This message is displayed when the instrument has been connected to a spectrum analyzer. When it is displayed, input the command data of the spectrum analyzer.

3.7.4 Error Messages

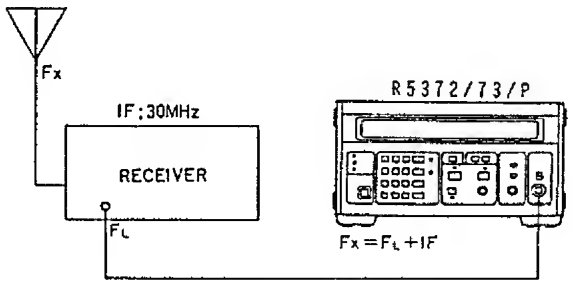
If a fault is detected in the instrument, one of the following error messages is displayed. If an error message is displayed, contact your nearest Advantest's representative.



3.8 Measurement Application Example

3.8.1 Measuring Frequency of a Radio with the IF Offset Display

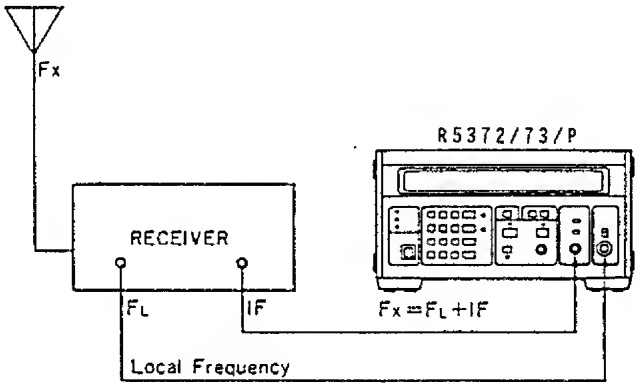
By using the IF offset display function of the unit, the reception frequency of a radio can be measured. The procedure is as follows: set the IF frequency of the heterodyne receiver as the offset frequency, then input the frequency from the keyboard. The reception frequency is displayed by measureing the local frequency.
In the 3.6.2 offset display application example, the operating method takes this reception frequency as an offset data. When the reception frequency is higher tnan the local frequency, the IF frequency is used without any modification. When the reception frequency i slower than the local frequency, the IF frequency is used as negative data.



3.8.2 Accurate Measurement of Radio Reception Frequency

The unit reciprocally measures any two input frequencies, given input A frequency and input B frequency, and displays the sum or difference of these two measured values. Accordingly, by connecting the IF signal of a heterodyne receiver or a local signal to the input A or input B , the correct reception frequency can be read directly.

This is an applied example of 3.6.3 operational display between the measurement data. The IF frequency is used straight forward if the reception frequency is higher than the local frequency. When the reception frequency is lower than the local one, IF frequency is used as negative data.



3.8.3 Measuring FM Deviation Quantity of Switching Station (STL or FPU)

This unit can be used to easily measure the FM deviation quantity.

(1) Using the internal sample rate method

This method is a sampling method, which is often used on similar units. Use the same connections as for measuring a normal continuous wave. For the operational functions, the display items of maximum value (MAX), minimum value (MIN) and change width (ΔF) in 3.6.9) are used.

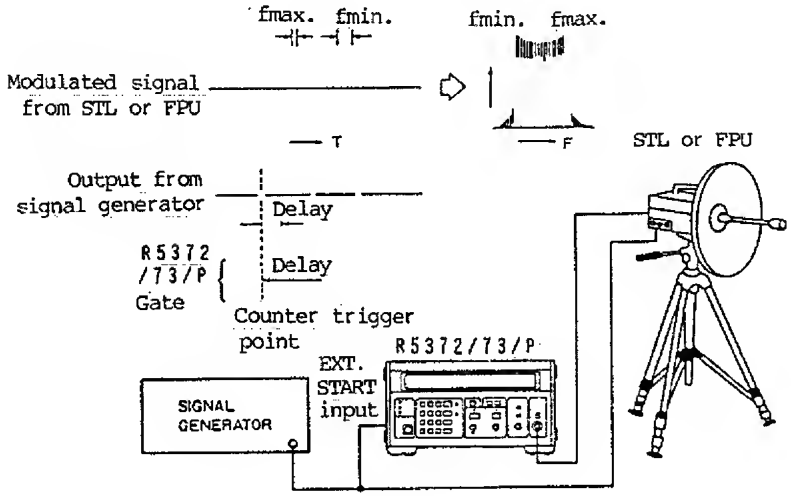
The FM deviation quantity can be automatically measured by measuring the ΔF item. The optimum gate time for this is shown in Figure 3-12. This method is effective only when the internal sample rate and FM modulated signal are asynchronous. If they are synchrouous, turn the sample rate knob at random to break the synchronism. Also, measure as many times as possible to upgrade the measurement precision.

(2) Using the external start signal method

This method is the alternative to burst wave measurement. It depends completely on the DELAYED GATE of 3.5.2 EXT. START in 3.5 Synchronous Trigger Mode. In order to measure, first set the maximum value (MAX), then turn the delay knob to measure the maximum value. Next, set the mimimum value (MIN), and turn the delay knob to measure the minimum value. Then, the FM deviation quantity can be obtained by setting the change width (Δ F).

Also, FM deviation quantity can be obtained by setting the change width (ΔF) after the measurement of the maximum, then turning the delay knob to bring the change width (ΔF) to its maximum.

The most suitable gate time for this is shown in Figure 3-12.



FM deviation quantity measurement example

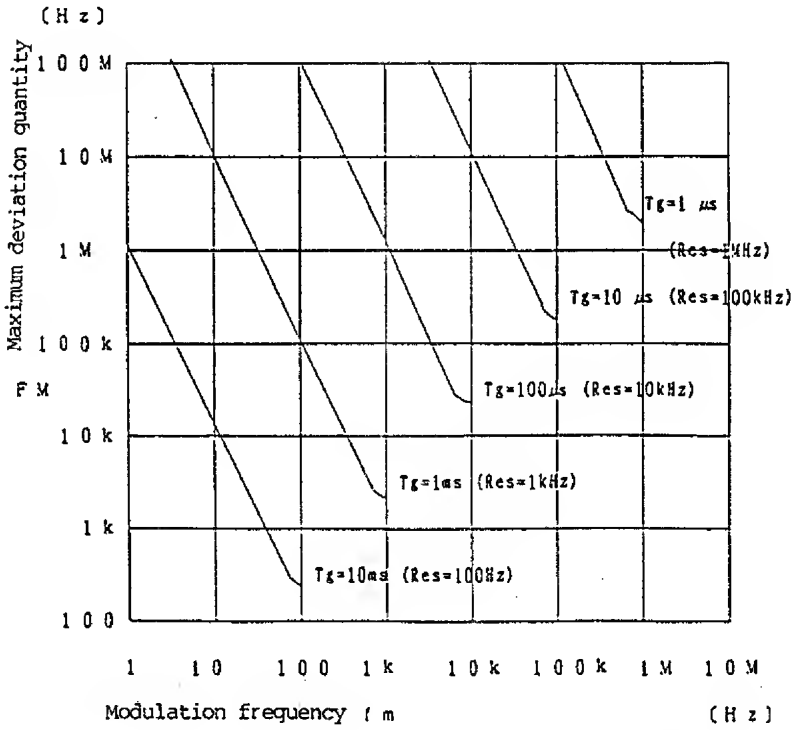
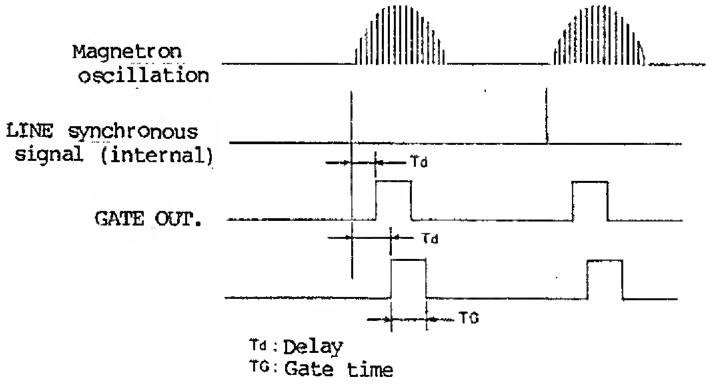


Figure 3 - 9 The Optimum GATE Time for FM Deviation

3.8.4 Measuring the Magnetron Oscillation Frequency of a Microwave Oven

Since the magnetron of a microwave oven intermittently oscillates synchronized with the line frequency, it is difficult to measure using a coventional frequency counter. With this unit's gate signal synchronized with the line frequency, the magnetron oscillation frequency can be easily measured.
The measurement example (a practical example of 3-8. Burst wave measurement) uses the LINE tregger.



Erectronic Magnetron Oscillation Frequency Measurement

4. PERFORMANCE TEST

4.1 Preparation for Performance Test

This section explains how to test the performance of the R5372/5372P/R5373/5373P Microwave Frequency Counter. Tables 4-1 and 4-2 list the equipment and tools required for the performance test. The performance specifications of the equipment listed in Table 4-1 are the minimum requirements to be met.

Table 4 - 1 Equipment Required for Performance Test

Equipment	Specifications
Signal generator	Frequency : 10 mHz to 18 GHz (27 GHz) Output level : 0 to -30 dBm Output impedance : 50 Ω (Other impedance value may be allowable below 10 MHz Output level flatness : ±0.5 dB Frequency accuracy : ±0.01% PRF output : Pulse-modulated wave width of 0.5 µs or more
Oscilloscope	Frequency range : 100 MHz Input sensitivity : 10 mV/div or more
Regulated voltage source	Output voltage : +5 V Output current : 10 mA or more
High-frequency power meter	Frequency range : 10MHz to 18 GHz (27 GHz) Sensitivity : -30 to +10 dBm Accuracy : ±0.5 dB
Pulse generator	Pulse width : 50 ns to 0.1 s Output level : 5 Vp-p or more
Pulse modulator	Frequency range : 100 MHz to 18 GHz (27 GHz) On/Off ratio : 40 dB or more Minimum RF pulse width: 50 ns or less
Low-frequency AC voltmeter	Frequency range : 10mHz to 10MHz Sensitivity : 1mVrms to 100mVrms

Table 4 - 2 Tools and Jigs Required for Performance Test

Item	Stock No.	Remarks
Input cable	A01036-1500	BNC-BNC
Input cable	MI-04	N-N
Connection cable	MC-36	BNC-UM
Connection cable	MC-37	BNC-SMA
Connection cable	MC-68	14 Pins & 50 pins
Connection cable	MO-09	24 Pins & 24 Pins
Connection cable	MO-01	50 Pins & 50 Pins
Conversion adapter	JUG201	NP-BNCJ
UM-UM linear adapter		UM-QA-JJ
Extender board		BGF-011265

4.2 Self-Performance Checks

Carry out the self-performance checks as explained in 3-4-1 to test the general performance of the instrument.

4.3 Performance Test Using Various Measuring Instruments

This section explains how to test the principal performance of the instrument using various measuring instruments. (See also 1.3 and 4.1) To initialize the instrument, press the ☐ MASTER RESET switch.

4.3.1 Checking Frequency Range and Input Sensitivity of INPUT A

Specifications:

Frequency range : 10 mHz to 550 MHz

Input sensitivity: 25 mVrms

Required instruments:

Signal generator (SG)

High-frequency power meter

AC voltmeter

(1) Press the ☐ MASTER RESET switch, and then make the following settings:

INPUT SELECT switch: A

ANS switch : ON

Frequency band selection switch: [10 MHz to 550 MHz]

SAMPLE RATE control: OFF

(2) Set the signal generator output frequency to 550 MHz, connect it to the high-frequency power meter, and set the output level to 25 mVrms (-19dBm).

(3) Apply the output of the signal generator to the INPUT A connector of the instrument. Make sure that the readout of the instrument displays the input frequency. Also verify that the uncertainties of the displayed frequency are within the range of the signal generator's stability ±1 count.

(4) Change the signal generator's frequency setting, set the output level to 25/mVrms (-19dBm), and make sure that the instrument makes counting normally. Make this check for frequencies ranging from 550 MHz to 10 MHz.

(5) Change the settings as follows:

ATT: 0 dB

Frequency band selection switch: [10 mHz to 10 MHz]

(6) Apply the output of the signal generator to the AC voltmeter and set its output level to 25 mVrms.

(7) Apply the output of the signal generator to the INPUT A connector of the instrument.

(8) Turn the LEVEL control fully counterclockwise to the AC position and confirm that the instrument counts normally.
At this time, the uncertainties of the displayed frequency are the sum of the signal generator's stability and the trigger error.
For the [10 mHz to 10 MHz] band, the instrument operates on the reciprocal scheme so that it is operable with a higher resolution than ordinary frequency counters. For that band, the upper markings (MHz, kHz, Hz, and mHz) are the readout units.

(9) Turning the LEVEL control over the range of -1 to +1 V, find a range in which correct frequency counting is made, and set the level at the center of the range.

(10) Change the frequency setting of the signal generator, set the output level to -19dBm, and make sure that the instrument counts normally. Make this check over the frequency range from 10 MHz to 10 mHz.

4.3.2 Checking Pulse Width Measurement Range for INPUT A

Specifications:

Pulse width : 50 ns to 1 s

Trigger level: -1 to +1 V

Required instruments:

Pulse generator (PG)

Oscilloscope

(1) Press the MASTER RESET switch and make the following settings:

INPUT SELECT switch: A

ATT switch : 0 dB

Frequency band selection switch: [10 mHz to 10 MHz]

SAMPLE RATE control : OFF

(2) Press the SHIFT and PW 2 switches.

(3) Set the pulse generator as follows:

Pulse width : 50 ns (positive pulse)

Output level : 75 mVp-p

Offset voltage : 0 V

Repetitive frequency: 10 MHz

(4) Apply the output of the pulse generator to the INPUT A connector of the instrument, and, turning the LEVEL control, make sure that the pulse width is displayed in microseconds.

(5) Turn the LEVEL control fully clockwise; adjusting the pulse generator offset voltage, determine the voltage at which the instrument operates normally, connect the PG output to the oscilloscope, and verify that the offset voltage is approximately +1 V.

(6) Turn the LEVEL control counterclockwise until it reaches a position just before AC; adjusting the pulse generator output offset voltage, determine the voltage at which the instrument operates normally, and verify that the offset voltage is approximately -1 V.

(7) Press the 4 switch and make sure that the negative pulse width is measured and that "—" is displayed. Also verify that the displayed pulse width value is equal to the repetition period set in step (3) minus the positive pulse width displayed in step (4). The polarity is reversed every time the 4 switch is pressed.

(8) Changing the pulse width and repetition period, make sure that the instrument operates normally.

4.3.3 Checking Frequency Range and Input Sensitivity for INPUT B

Specifications:

Frequency range : 500 MHz to 18 GHz (R5372/P)
500 MHz to 27 GHz (R5373/P)
Input sensitivity: -20 dBm (500 MHz to 18 GHz)
-15 dBm (18 to 27 GHz)

Required instruments:

Signal generator (SG)
High-frequency power meter

(1) Press the MASTER RESET switch and initialize the instrument as follows:
INPUT SELECT switch: B
RF ATT switch : AUTO
SAMPLE RATE control: OFF

(2) Set the signal generator to 18 GHz, connect it to the high-frequency power meter, and set the output level to -20 dBm.

(3) Apply the above output of the signal generator to the INPUT B connector of the instrument.
Make sure that the display of the instrument indicates the input frequency. Also verify that the ambiguities of the displayed readout are within the range of the signal generator's stability ±1 count ±($\frac{1}{10}$ x input frequency in GHz).

(4) Change the frequency setting of the signal generator, adjust the output level, and make sure that the instrument makes counting normally. Make this check for frequencies up to 500 MHz.

(5) For the R5373/P, check that the instrument makes counting normally over the frequency range of 27 to 18 GHz with an input sensitivity of -15 dBm.

4.3.4 Totalize

Specifications:

Frequency range : DC to 10 MHz

Counting capacity: 0 to $10^{10}-1$

Required instrument:

Pulse generator (PG)

(1) Press the MASTER RESET switch and change the settings as follows:
INPUT SELECT switch: A
Frequency band selection switch: [10 mHz to 10 MHz]

(2) Setting pulse generator as follows:
Pulse width : 50 ns (positive pulse)
Output level : 75 mVp-p
Offset voltage : 0 V
Repetitive frequency: 10 MHz

(3) Apply the output of the pulse generator that has been set as above to the INPUT A connector of the instrument. Adjust the trigger level using the LEVEL control; the readout displays the input signal frequency.

(4) Press the SHIFT and TOT A 3 switches and make sure that the readout displays " 0 ".

(5) Press the RESET ON/OFF switch and make sure that counting starts and that the count value increases.

(6) Press the RESET ON/OFF switch again and make sure that counting stops and that the displayed count is held.

(7) Press the RESET ON/OFF switch one more time and make sure that the display is cleared and that counting starts again.

(8) After once stopping counting by pressing the RESET ON/OFF switch, press the HOLD and RESET ON/OFF switches and make sure that counting restarts to continue from the last count.

4.3.5 Burst Wave Carrier Frequency Measurement

Specifications:

Frequency range: 100 MHz to 18 GHz (R5372/P)
100 MHz to 27 GHz (R5373/P)

Pulse width : R5372/73 : 0.5μs min.
R5372P/73P: 100 ns to 0.1 s (internally synchronized)
50 ns to 0.1 s (externally synchronized)

Required instruments:

Signal generator (SG)
Pulse generator (PG)
Pulse modulator
High-frequency power meter

(1) Press the MASTER RESET switch and initialize the instrument as follows:

INPUT SELECT switch: B
RF ATT switch : AUTO
SAMPLE RATE control: OFF

(2) Set the signal generator to 18 GHz and connect it as shown in Figure 4-1.

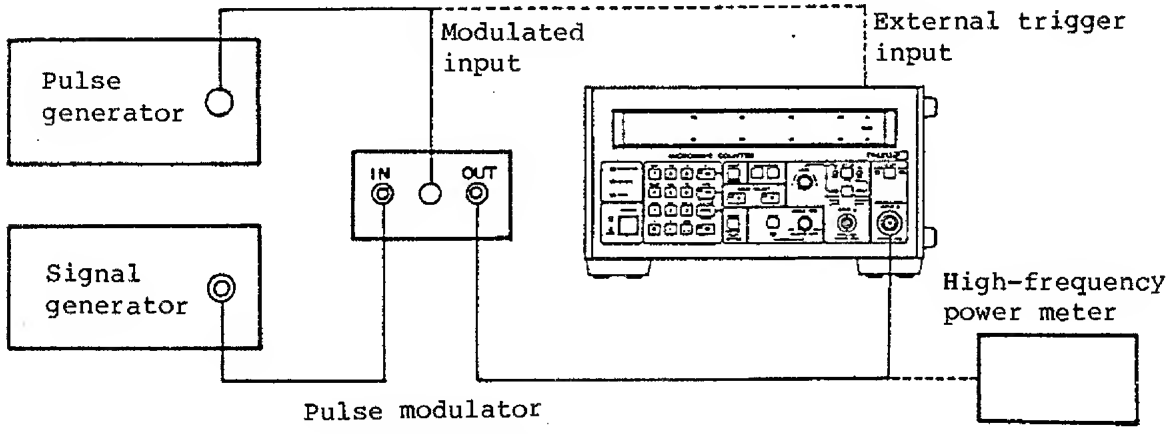


Figure 4 - 1 Instrument Connections for Burst Wave Carrier Frequency Measurement

(3) Change the pulsed RF signal to the RF continuous wave signal by deactivating the pulse modulator. Next, measure the output of the pulse modulator with the high-frequency power meter and adjust the output of the signal generator to bring the output of the pulse modulator to -20 dBm.

(4) Apply the output of the pulse modulator to the INPUT B connector of instrument and confirm that the readout values display the input frequency.

(5) Operate the instrument into the burst wave carrier frequency measurement mode.
① Press the MANUAL and ENTER switches.
② Set the instrument to HOLD by pressing the HOLD switch.
③ Set the DELAYED GATE control to OFF by turning it counterclockwise.
④ Set the TRIG MODE switch on the rear panel to INT.

(6) Set the resolution to 10 MHz using the RESOLUTION switches.

(7) Set the output of the pulse generator to 100 ns, start modulation by the pulse modulator. See that the instrument makes counting normally and that the readout displays the input frequency in 10 MHz units.

[Procedures (8) to (17) are applicable to R5372P/5373P.]

(8) Set the output of the pulse generator to 1 µs.

(9) Confirm that at each press of the RESOLUTION switch ◇ the resolution display is raised by one digit causing the lowest- order digit of measurement to correspondingly change; first down to the digit for MHz, next to the digit for hundreds of kHz, then to the digit for tens of kHz, finally to the digit for kHz.
Note that, whereas the measurement can be displayed down to the digit of 10 kHz in a minimum of 0.5 second, displaying the measurement down to the digit of 1 kHz requires at least 50 seconds.

(10) Stop modulation by the pulse modulator.

(11) Set the TRIG MODE switches on the rear panel of the instrument to EXT GATE, and apply the output of the pulse generator that has been set to 50 ns to the EXT IN connector. The pulse signal is of TTL negative.
When the output impedance of the pulse generator is 50 Ω, connect a 50 Ω feedthrough terminator to the EXT IN connector of the instrument.

(12) Set the resolution to 10 MHz using the RESOLUTION switches. Make sure that the instrument counts normally and that the input signal frequency is displayed in 10 MHz units.

(13) Press the RESOLUTION switch ⊡ once. Make sure that measurement is made with a resolution of 1 MHz.
Next, press the same RESOLUTION switch more times, and make sure that the resolution is raised by one digit each; first to 100 kHz, then to 10 kHz. At the same time, verify that the accuracy of the displayed frequency is within ±1 count ±time base accuracy $\pm\frac{0.04}{GW}$[Hz rms] ±5 kHz. (GW is the pulse width of the output of the pulse generator applied to the EXT IN connector.)

(14) Change the pulse width of the output of the pulse generator and the resolution setting on the instrument. Check the display accuracy.

(15) Change the output frequency of the signal generator and the manual frequency setting on the instrument. Perform steps (1) through (14).

(16) Repeat step (15).

(17) Also perform steps (1) through (16) for INPUT A over the frequency range of 100 to 550 MHz.

4.3.6 Burst Wave Pulse Width Measurement (R5372P/73P)

Specifications:

Pulse width: 0.1 μs to 0.1 s

Required instruments:

Signal generator (SG)

Pulse generator (PG)

Pulse modulator

High-frequency power meter

(1) Press the MASTER RESET switch and initialize the instrument as follows:

INPUT SELECT switch: B

RF ATT switch : AUTO

SAMPLE RATE control: OFF

(2) Set the signal generator to 18 GHz and connect it as shown in Figure 4-1.

(3) Change the pulsed RF signal to the RF continuous wave signal by stopping the modulation operation of the pulse modulator. Next, measure the output of the pulse modulator with the high-frequency power meter, and adjust the output of the signal generator to bring the output of the pulse modulator to -20 dBm.

(4) Apply the output of the pulse modulator that has been set to -20 dBm to the INPUT B connector of the instrument. Make sure that the readout of the instrument displays the input frequency.

(5) Set the instrument into the carrier frequency measurement mode of burst wave as follows:

1 Press the MANUAL and ENTER switches.

2 Press the HOLD switch.

3 Set the DELAYED GATE control to OFF by turning it counterclockwise.

4 Set the TRIG MODE switch on the rear panel to INT.

(6) Press the SHIFT and PW 2 switches.

(7) Set the output of the pulse generator to 100 ns, start pulse modulation. Verify that the pulse width is displayed in microseconds with a resolution of 10 ns.

(8) Change the pulse width setting on the pulse generator and check the display.

5. METHODS FOR MAINTENANCE, INSPECTION AND CALIBRATION

This chapter describes the precautions on the basic operation check, maintenance and inspection of the R5372/73/P Micro Wave Frequency Counter and the calibration method. After a repair of a defective part, be sure to check the operation and calibrate before use.

5.1 Maintenance and Inspection

(1) Precautions on maintenance and repair

When opening the case of this machine for the maintenance, inspection or repair, turn off the POWER switch and remove the power cable from the receptacle. Because the stabilizing circuits of the power transformer and power supply always feed power to the reference-time oscillator (X'tal OSC) even if the POWER switch is off, never touch the power cable except when it is removed from the receptacle.

(2) Precaution for transferring this instrument

Because a crystal resonator is used for this instrument, take a great care when handling so as excessive mechanical impact.

(3) Ordinary operation check method

When the POWER switch of this instrument is set to ON, the self-diagnostic function is automatically executed. See 3.1 Basic Operation Method. During the operation, a variety of error messages and command messages are displayed. Referring to 3.7 Command/Error Messages, operate the instrument properly.

5.2 Calibration for Internal Time-base Accuracy

The most important element for the instrument to maintain high measurement accuracy is the oscillation accuracy of the crystal oscillator that generates the internal time base. The oscillation must be constant; its fluctuation must be of the least degree. To maintain the high measurement accuracy of the instrument, it is necessary to calibrate the instrument using a reliable frequency standard.

The measurement accuracy of the instrument depends on the crystal oscillator incorporated in it, but a highly stable crystal oscillator does not necessarily ensure highly accurate measurement unless it is accurately calibrated. For example, if a crystal oscillator having an ultrahigh stability of 2×10^{-8}/day is calibrated to an accuracy of 1×10^{-6}, the accuracy of the crystal oscillator fluctuates only in the narrow range of 1×10^{-6} to 2×10^{-8}/day, but the measurement accuracy of the instrument incorporating the crystal oscillator cannot surpass 1×10^{-6}. In such a case, the ultrahigh stability of the crystal oscillator is not effectively used. It is also meaningless to apply very high accuracy in calibrating a crystal oscillator which has poor stability. It is most effective to calibrate a crystal oscillator applying high accuracy which matches the stability of the crystal oscillator.

(1) Instruments needed for calibration

Frequency standard
Output : 1 or 10 MHz
Accuracy: 1×10^{-10} or higher
Frequency comparator

(2) Precautions

a. After powering the instrument, allow it to warm up for at least 24 hours.

b. Allow the instruments to be used for calibration to warm up for the specified amount of time.

(3) Calibration procedure

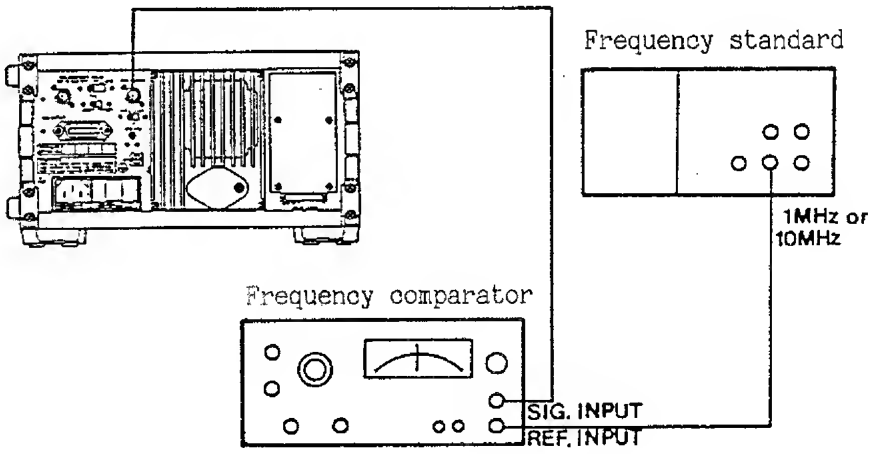


Figure 5 - 1 Calibration using frequency standard

① Set the STD EXT/INT switch on the rear panel of the instrument to INT, and connect the STD IN/OUT connector and the signal input connector of the frequency comparator with a cable.

② Connect the output connector of the frequency standard and the reference signal input connector of the frequency comparator with a cable.

③ Set the frequency comparator meter range.
Standard specification: 10^{-8} range
Option 21: 10^{-9} range
Option 22: 10^{-9} range
Option 23: 10^{-10} range

④ Adjust the STD ADJ on the rear panel of the instrument to bring the pointer swinging on the comparator meter within the specified stability range.

(4) Replacement procedure

① Remove the ring that holds the BNC barrel of the connector by turning it counterclockwise.

② Remove the fuse to be replaced.

③ Insert the replacement fuse whose leads have been cut to size as shown in the (3) above into the center hole in the BNC barrel of the connector. (Turning the fuse or the BNC barrel of the connector will make the insertion easier.)

④ Aligning the stopper in the fixed portion of the connector and the slit in the BNC barrel, insert the fuse into the fixed portion of the connector.

⑤ Lightly turn the BNC barrel rotating ring clockwise.

⑥ Tighten the rotating ring.

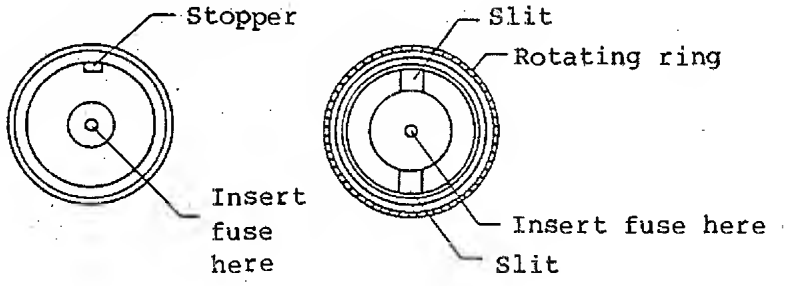
5.3 Fuse Replacement in Input a Connector

The INPUT A connector of the instrument contains a protective fuse. To replace the fuse, use the following procedure:

(1) Fuse specification

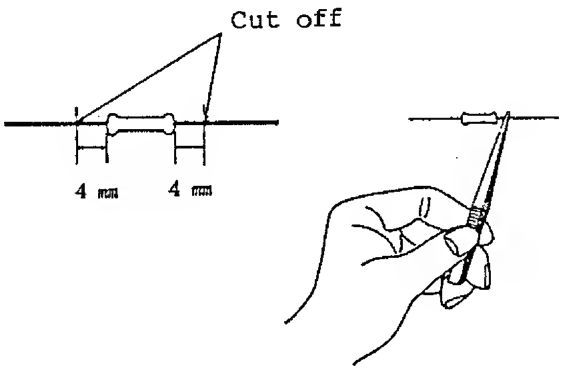
Part name	TR Stock No.	Specification No.	Maker
Subminiature picofuse, axial leads 1/8 A	DFS-AGR125A-1	275.125	Littelfuse, Inc.

(2) Connector structure



Portion fixed to R5372P/5373P BNC barrel

(3) Cutting fuse leads



To cut the leads of a fuse, hold the lead with a pair of tweezers as shown above without giving stress to the fuse and cut the lead on the other side with a pair of sharp-edged nippers.

(4) Replacement procedure

① Remove the ring that holds the BNC barrel of the connector by turning it counterclockwise.

② Remove the fuse to be replaced.

③ Insert the replacement fuse whose leads have been cut to size as shown in the (3) above into the center hole in the BNC barrel of the connector. (Turning the fuse or the BNC barrel of the connector will make the insertion easier.)

④ Aligning the stopper in the fixed portion of the connector and the slit in the BNC barrel, insert the fuse into the fixed portion of the connector.

⑤ Lightly turn the BNC barrel rotating ring clockwise.

⑥ Tighten the rotating ring.

5.4 Diagnosis

Symptom	Inspection Point
Nothing is displayed.	• Inspect the power cable and power supply fuse.
The display is not initialized.	• Check whether the STD EXT/INT switch on the rear panel is set to EXT. When the switch is set to EXT, check whether an external signal is connected.
During the check operation, the R5372/73 and R5372P/73P do not display 10 MHz and 100 MHz respectively.	• Unless the COUNTING lamp of the front panel blinks, check the boards BGF-017274 and BGF-010897. • If nothing is displayed although the COUNTING lamp of the front panel blinks, check the board BGF-017275.
No count begins upon input A.	• Check the input fuse. • If no count begins with 10 MHz through 550 MHz, check the board BGF-017275. • If no count begins with 10 mHz through 10 MHz, check the board BGB-017279.
No count occurs upon input B.	• Check the MEP-361.

6. ADJUSTMENT

6.1 Introduction

This section describes adjustment procedures for the R5372/5373/5372P/5373P Microwave Counters required after basic operational check or performance test. Calibration and performance test is required after the instrument is serviced.
Part numbers or symbols appearing in schematic diagrams or printed circuit boards are directly referred in this manual for quick identification.

6.2 Preparation

Tables 6-1 and 6-2 list equipment and tools required for adjustment.

Table 6 - 1 Equipment Required for Adjustment

Equipment	Specification required	Recommended model
Signal generator	Range: 10 MHz to 27 GHz Output level: +10 dBm to -30 dBm Output impedance: 50 Ω Output level flatness: ±0.5 dB Accuracy: ±0.01% PRF output: Pulse modulation width of 50 ns or more	
Frequency counter	Range: 400 kHz to 1000 MHz Input sensitivity: 10 mVrms Stability: 5×10^{-8}/day	TR5825 (Advantest)
Digital multimeter	Range: 0 V to ±1000 V Accuracy: ±0.1% of rdg. Input impedance: 10 MΩ or more	TR6841 (Advantest)
Spectrum analyzer	Range: 100 kHz to 20 GHz With tracking generator (to 500 MHz)	TR4122B, TR4133B (Advantest)

Table 6 - 1 Equipment Required for Adjustment (Cont'd)

Equipment	Specification required	Recommended model
Oscilloscope	Range: 100MHz Input sensitivity: 10 mV/div. or more	
Regulated DC power supply Power meter	Output voltage: +5 V Output current: 10 mA or more Frequency range: 100 kHz to 27 GHz Sensitivity: -30 dBm to +10 dBm Accuracy: ±0.5 dB	
Digital printer	Print digits: 9 digits of data Input code: BCD (8-4-2-1) code, positive logic Logic 1: +2.4 V to +18 V Logic 0: 0 V to +0.6 V	TR6196 or TR6198 (Advantest)
Pulse generator	Pulse width: 50 ns to 0.1s Output level: 5 Vpp or more	
Pulse modulator	Range: 100 MHz to 27 GHz ON/OFF ratio: 40 dB (min.) Minimum RF pulse width: 50 ns or less	

Table 6 - 2 Tools and Jigs Required for Adjustment

Item	Stock No.	Remarks
Input cable	M1-02	BNC-BNC
Input cable	M1-04	N-N
Input cable	A01002	OSM-OSM
Interconnecting cable	MC-36	BNC-UM
Interconnecting cable	MC-37	BNC-SMA
Interconnecting cable	MC-68	14 pins - 50 pins*
Interconnecting cable	MO-09	24 pins - 24 pins
Interconnecting cable	MO-01	50 pins - 50 pins
Cable adapter	JUG20	NP-BNCJ*
UM-UM linear adapter		UM-QA-JJ*
Extender board		BGF-011265*

*: Contents of maintenance kit (A08807)

6.3 General Precautions

(1) The instrument should be powered from an electrical outlet supplying line voltage of 100, 120, 200, or 220 Vac ±10%, or 240 Vac -10% to +4% depending on the card of the instrument (line frequency: 50/60 Hz).

(2) Before plugging the instrument into an electrical outlet, make sure that the POWER switch is set to OFF.

(3) The power plug has three prongs, the center prong being for ground. When using a plug adapter for power connection, be sure to connect the ground line of the adapter or the instrument's rear GND terminal to earth ground. (See Figure 1-1)

(4) During calibration, the ambient temperature should be kept between +20°C and +30°C, and the relative humidity below 80%. The working environment should be free of dust, vibration, and noise.

(5) This instrument incorporates a crystal oscillator, so be careful not to subject it to excessive mechanical shock.

(6) Before removing the case of the instrument for maintenance, inspection or repair, set the POWER switch to OFF, and unplug the power cable from the power outlet.
The power transformer and the stabilizing circuit in the power supply section continue to power the time-base oscillator even when the power switch is set to OFF. Therefore, do not touch them unless the power cable has been unplugged from the power outlet.

6.4 Supply Voltage Adjustment

Required equipment: Digital multimeter

(1) Check the impedances between power supply lines against those listed in Table 6-3.

(2) Remove the bottom cover from the instrument, and check the supply voltages at each test point(TP) on the MOTHER BOARD (BLK-010921 or BLK-012204) against those listed in Table 6-4.

Table 6 - 3 Impedance Between Power Supply Lines

POWER switch	OFF	ON
Impedance	Approx. 3.8 Ω	Approx. 3.8 Ω

Table 6 - 4 Supply Voltages at Each Land

Switch status	POWER switch	OFF	ON
voltage	+5 V (TP2) - 0 V (TP1)	0 V	+5(±0.5) V
	+12 V (TP4) - 0 V (TP3)	0 V	+12(±0.5) V
	+12 V (TP5) - 0 V (TP3)	+12 V(±0.5) V	+12(±0.5) V
	-12 V (TP6) - 0 V (TP3)	0 V	-12(±0.5) V

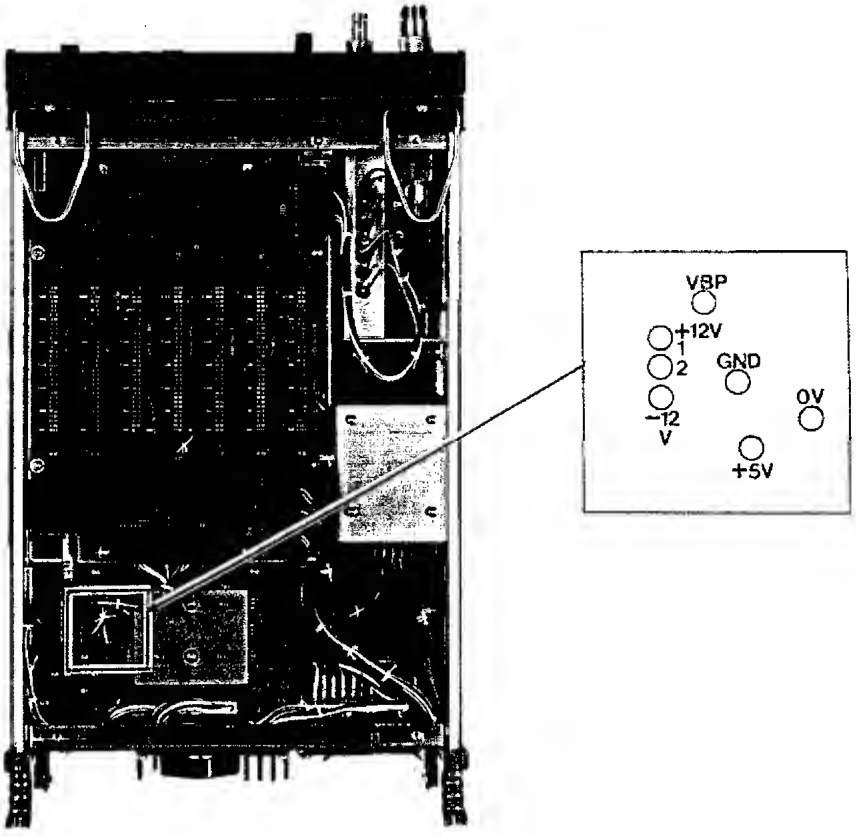


Figure 6 - 1 Supply Voltage Test Points

6.5 Key and Display (BLG-010890 or BLG-012206) Adjustment

See Subsection 3.6.12 Checking Function.

6.6 LOW F AMP (BGB-011161) Adjustment

Remove the top cover to gain access to the two controls for the LOW F AMP Schmitt trigger adjustment:
R54: DC trigger level adjustment control
R57: AC trigger level adjustment control
(See Figure 6-2)

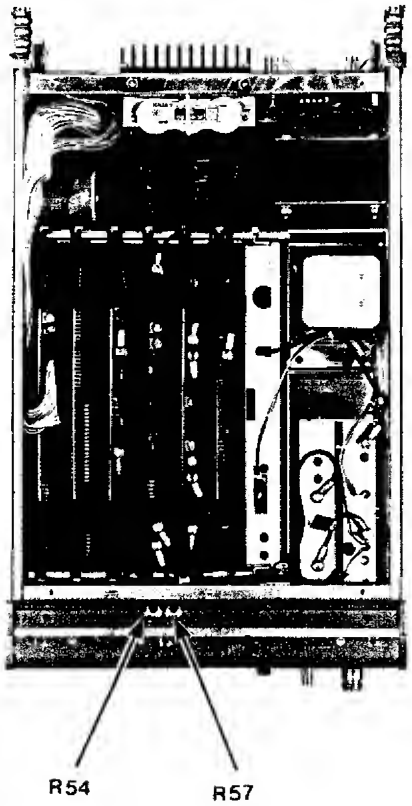


Figure 6 - 2 LOW F AMP Adjustment Controls Location

6.6.1 DC Trigger Level Adjustment (R54)

Equipment to be used: Signal generator
Oscilloscope

① Set up for the LOW F AMP adjustment as shown in Figure 6-3. The GATE CONTROL (BGF-010892) can be raised for easy access as shown in Figure 6-3 by using the extender board (211265A).
Connect the signal generator output to the INPUT A connector of the counter.

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Set the INPUT SELECT switch TO A.
- Set the 10 mHz to 10 MHz/10MHz to 550 MHz switch to the 10 mHz to 10 MHz band (LED lamp on the corresponding band will belighted.).
- Set the ATT switch to 0 dB.
- Set the SAMPLE RATE control to OFF.
- Set the LEVEL control to the center of its range

③ Set the signal generator output for 10 MHz and -25 dBm.
Connect the oscilloscope synchronous probe to R70 (see Figure 6-3).

④ Set the oscilloscope TIME/div to 50 ns/div.

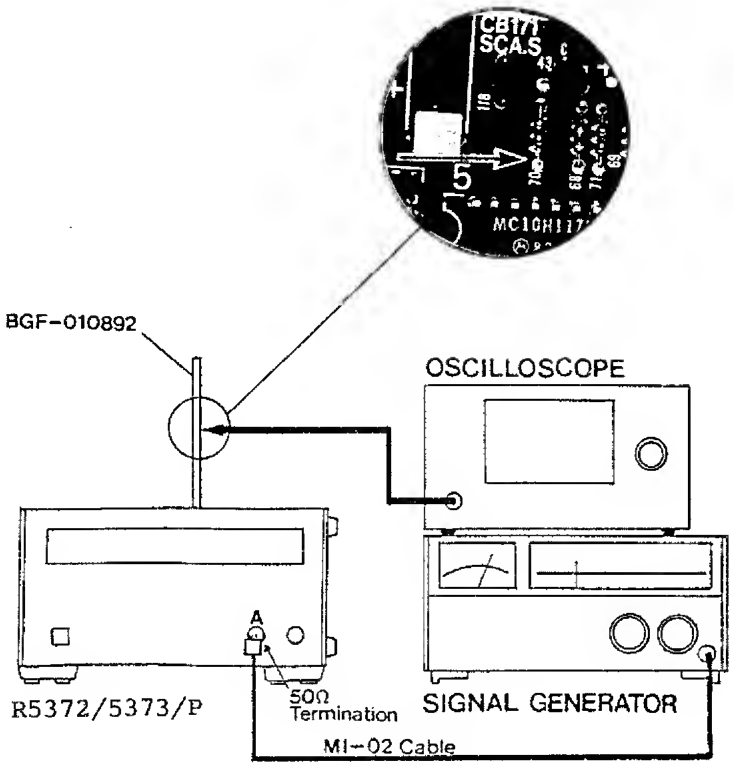


Figure 6 - 3 Setup for LOW F AMP Adjustment

⑤ Adjust R54 so that the duty factor on the oscilloscope output waveform is 50%. (See Figure 6-4)

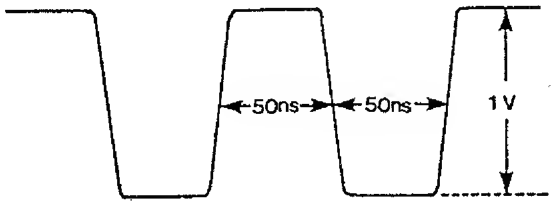


Figure 6 - 4 LOW F AMP Output Waveform

6.6.2 AC Trigger Level Adjustment (R57)

Equipment to be used: Signal generator
Oscilloscope

① Set up for the LOW F AMP adjustment as shown in Figure 6-3.

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- If the POWER switch is already ON, press the MASTER RESET switch, then set the INPUT SELECT switch to A.
- Set the 10 mHz to 10 MHz/10 MHz to 550 MHz switch to the 10 mHz to 10 MHz band.
- Set the ATT switch to 0 dB.
- Set the SAMPLE RATE control to OFF.
- Set the LEVEL control to the AC coupling.

(Turn the LEVEL control fully counterclockwise to the detent until it clicks.)

After this, adjust R57 in the same way as ③, ④ and ⑤ described in Subsection 6.6.1.

6.7 INPUT AMP & SCALER (BGF-010893 or BGF-012541) Adjustment

The INPUT AMP & SCALER has four controls for its adjustment: R131, R100, R141, and R157. (See Figures 6-5 and 6-6)

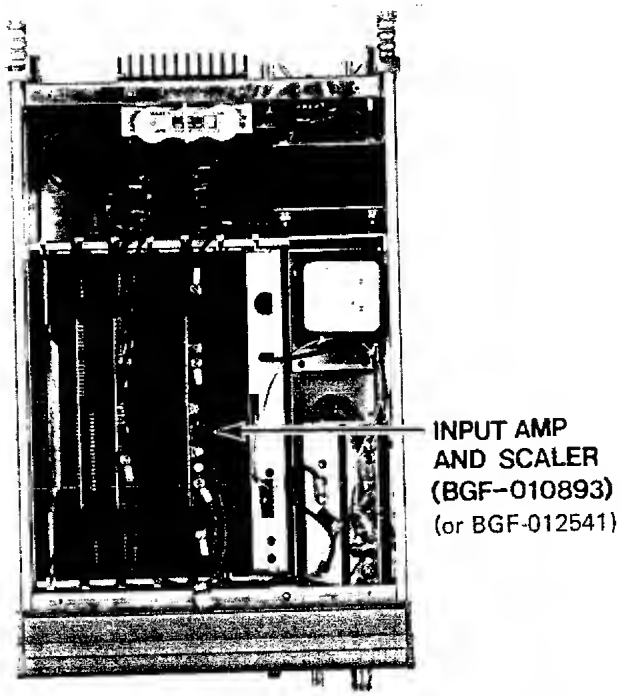


Figure 6 - 5 Location of INPUT AMP and SCALER (BGF-010893) (or BGF-012541)

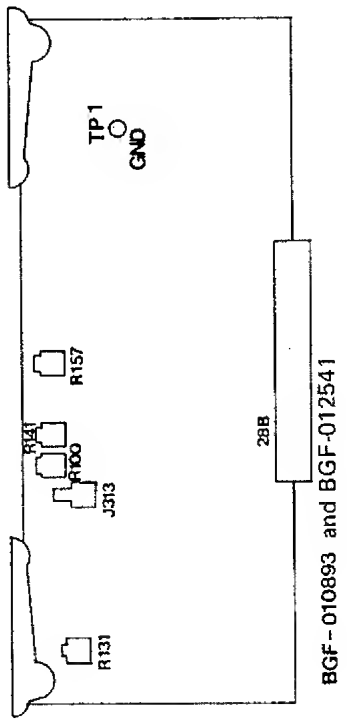


Figure 6 - 6 INPUT AMP & SCALER Adjustment Controls Location

R131: Input-A DET adjustment control (This control must be adjusted after the R100 and R141 controls.)

R100: Input-A AMP offset compensation control

R141: Input-A Schmitt trigger circuit bias adjustment control

R157: Input-B Schmitt trigger circuit bias adjustment control

Note: Frequency range

Input A: 10 to 550 MHz

Input B: 500 MHz to 18 GHz (R5372/5372P)

500 MHz to 27 GHz (R5373/5373P)

6.7.1 Offset Adjustment for INPUT A AMP (R100)

Equipment to be used: Signal generator
Oscilloscope

① Set up for the INPUT AMP & SCALER adjustment as shown in Figure 6-7. The INPUT AMP & SCALER (BGF-010893) can be raised for easy access as shown in Figure 6-7 by using the extender board (211265A). Connect the signal generator output to the INPUT A connector of the counter.

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Set the INPUT SELECT switch to A.
- Set the 10 mHz to 10 MHz/10 MHz to 550 MHz switch to the 10-550 MHz band.
- Set the ANS switch to OFF.

③ Set the signal generator output frequency to 10 MHz, then set its level to the minimum.
Connect the oscilloscope probe to R110 (470Ω)(see Figure 6-7).

④ Set the oscilloscope TIME/div to 50 ns/div, then set its level to 2 V/div.

⑤ Observing the waveform on the CRT display of the oscilloscope, increase the signal generator level by degrees, then adjust R100 so that the more positive waveform is symmetrical with the more negative waveform as shown in Figure 6-8.

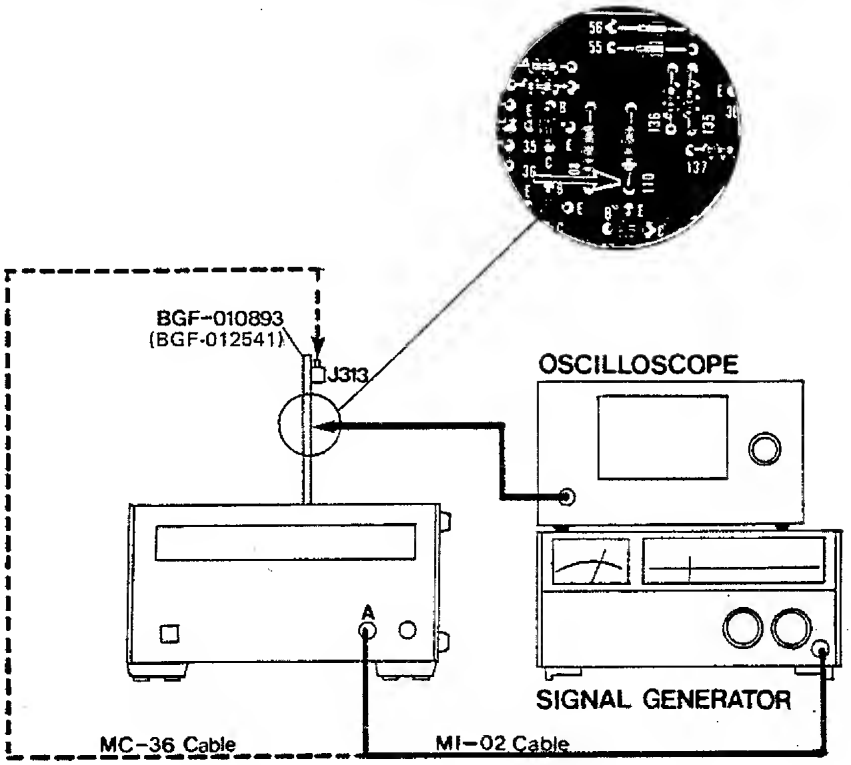


Figure 6 - 7 Setup for INPUT AMP & SCALER(BGF-010893) Adjustment

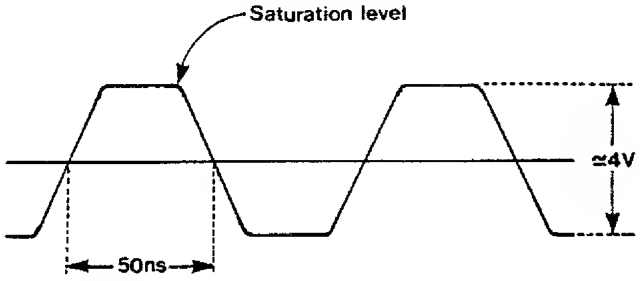


Figure 6 - 8 Waveforms for INPUT A AMP Offset Compensation

6.7.2 Bias Adjustment for Input-A Schmitt Trigger Circuit (R141)

Equipment to be used: Signal generator

① Connect the signal generator output to the INPUT A connector of the counter.

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON. If the POWER switch is already set to ON, press the MASTER RESET switch, then set the INPUT SELECT switch to A.
- Set the 10 mHz to 10 MHz/10 MHz to 550 MHz switch to the 10-550 MHz band.
- Set the ANS switch to ON.
- Set the SAMPLE RATE control to OFF.

③ Set the signal generator output for 550 MHz and -10 dBm.

④ Observing the display of the counter reduce the signal generator level, then adjust R141 so that the highest input sensitivity level is obtained.

6.7.3 Input-A DET Adjustment (R131)

Equipment to be used: Signal generator
Oscilloscope

Note: The R131 must be adjusted after the adjustment of R100 and R141.

① Set up for the INPUT AMP & SCALER adjustment referring to Figure 5-7. Connect the signal generator output to the INPUT A connector of the counter.

② Set the key switches on the front panel of the counter as follows:
- Set the POWER switch to ON.
- Set the INPUT SELECT switch to A.
- Set the 10 mHz to 10 MHz/10MHz to 550 MHz switch to the 10-550 MHz band.
- Set the ANS switch to ON.

③ Set the signal generator output frequency to 550 MHz and the highest input sensitivity level to +2 dB.

④ Connect the oscilloscope probe to the connector pin 28B (see Figure 6-6).

⑤ If the output of connector pin 28B is high (2.4 V to 5.0 V), adjust R131 so that it is set to low (0.0 V to 0.8 V). If the output is already low, adjust R131 to high, then turn R131 in opposite direction so that it is set to low.

6.7.4 Bias Adjustment for Input-B Schmitt Trigger Circuit (R157)

Equipment to be used: Signal generator

① Connect the signal generator output to J313 (IF IN) connector of the INPUT AMP & SCALER. (See Figure 6-7, in which the cable to be connected to J313 connector is designated with a broken line.)

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Press the [MNL], [ENTER], and [SHF] switches in order.
- Set the RF ATT switch to 20 dB.

③ Set the signal generator output for 350 MHz and -20 dBm.

④ Check that 350 MHz is displayed on the readout of the counter Then reduce the signal generator level by degrees, and adjust R157 so that the input-B Schmitt trigger circuit is set to the highest input sensitivity level.

6.8 RF BLOCK [MEP-361-01 (R5372/P)/MEP-361-02 (R5373/P)] and LOCAL CONTROL (BGF-010894) Adjustments

The RF block (MEP-361-01/02) consists of four blocks as shown in Figure 6-9:

- VCO BLB-010908
- PREAMP BLB-010909
- IF AMP BLB-010910
- SAMPLER SHB-000744-1 [THD-518L (R5372/P)]
  DHB-000859 [THD-522 (R5373/P)]

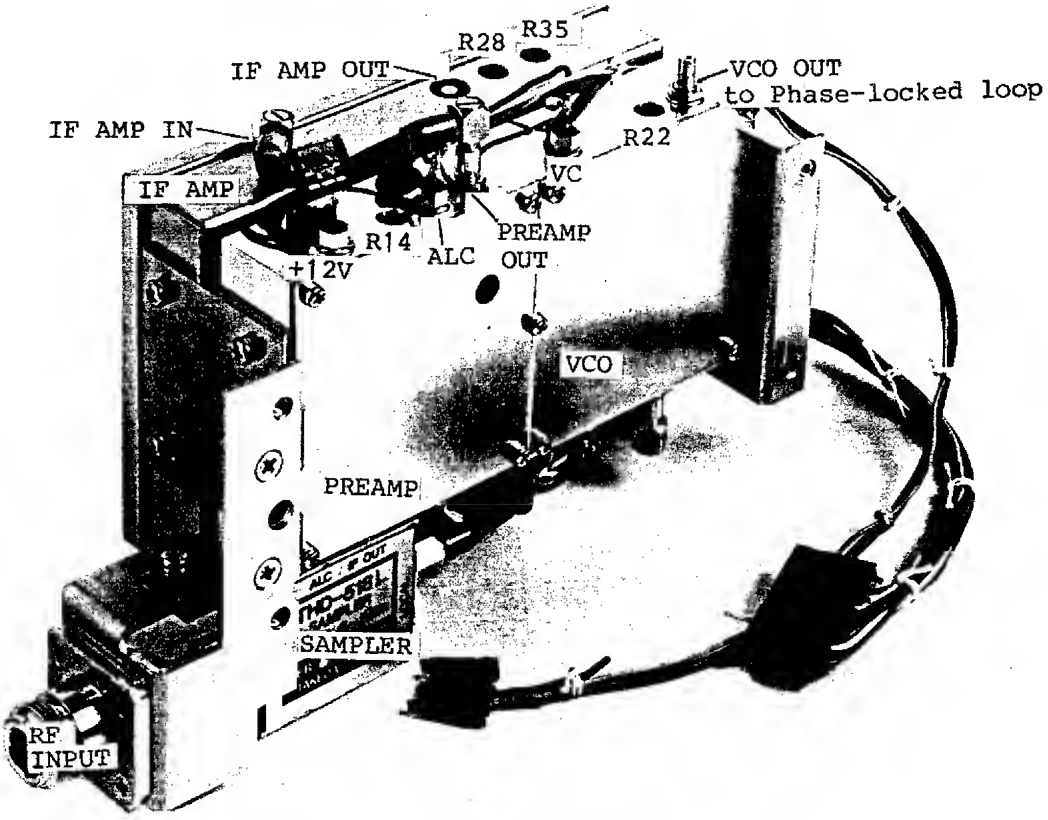


Figure 6 - 9 RF Block Assembly (controls and terminals location)

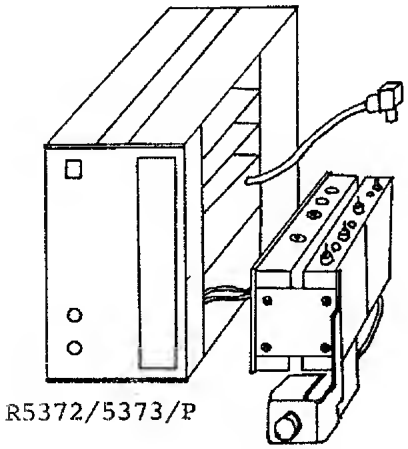
Because of the close relations with the LOCAL CONTROL(BGF-010894), the RF block requires overall adjustment including the LOCAL CONTROL as well as the adjustment of the individual building blocks of VCO(BLB-010908), SAMPLER(SHB-000744-1/DHB-000859), PREAMP(BLB-010909) or IF AMP(BLB-010910).

6.8.1 VCO (BLB-010908) Characteristics and Adjustment

Equipment to be used: Spectrum analyzer
Regulated DC power supply

① Remove the RF block as shown in Figure 6-10.

② Set up for VCO adjustment as shown in Figure 6-11.



Remove the RF block from the mainframe of the counter as follows.

① Remove the top and bottom covers from the mainframe.

② Remove the stack feet

③ Remove the side plates and side belt cover on the right side of the counter.

④ Remove screws which fix the RF block, taking care not to subject its terminals to a physical shock.

Figure 6 - 10 How to remove the RF block

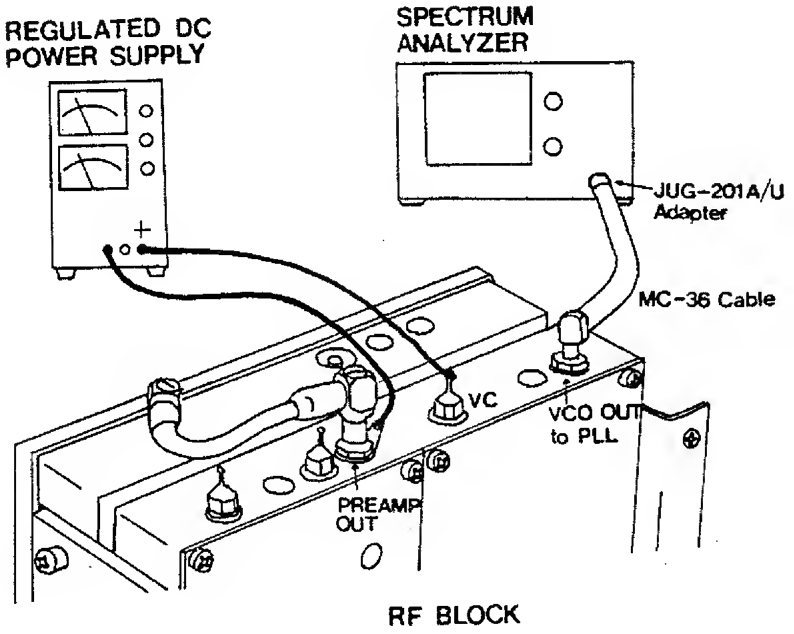


Figure 6 - 11 Setup for VCO Adjustment

③ Check that the J10 connector of the MOTHER BOARD (BLK-010921) is connected to the RF block; set the regulated DC power supply to 0 V; then set the POWER switch of the counter to ON.

④ Changing the VC input voltage within the range of -7 V to +7 V, observe the waveform on the CRT display of the spectrum analyzer. Check that the VCO output frequency is 800 MHz or higher for VC input voltage value of -5 V and that it is 1000 MHz or higher for VC input voltage value of +5 V as shown in Figure 6-12.
Figure 6-13 shows the relationships between the VCO output levels and VCO output frequencies when the VC input voltage is changed within the range of -5 V to +5 V.

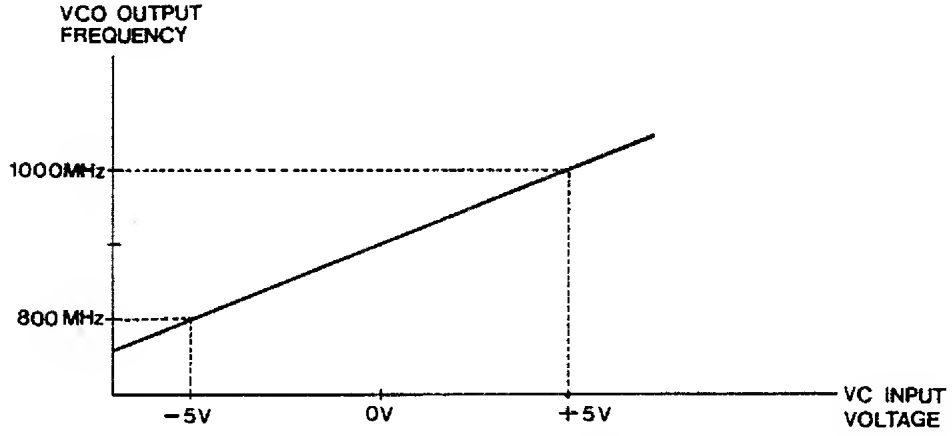


Figure 6 - 12 Relationships Between VC Input Voltage Values and VCO Output Frequencies

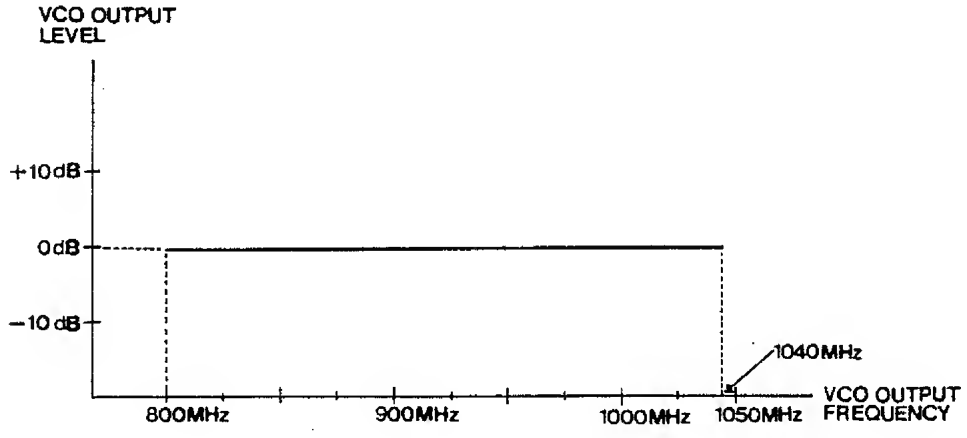


Figure 6 - 13 Relationships Between VCO Output Levels and Frequencies

6.8.2 IF AMP (BLB-010910) Characteristics and Adjustment

Equipment to be used: Spectrum analyzer
Signal generator
Digital voltmeter

① Remove the RF block as shown in Figure 6-10.

② Set up for IF AMP adjustment as shown in Figure 6-14.

③ Set the output level of the tracking generator in the spectrum analyzer to -50 dBm. Then, check that a waveform as shown in Figure 6-15 is displayed on the CRT screen of the spectrum analyzer.

④ Set the cut-off frequency to 350 MHz using trimmer capacitor C49.

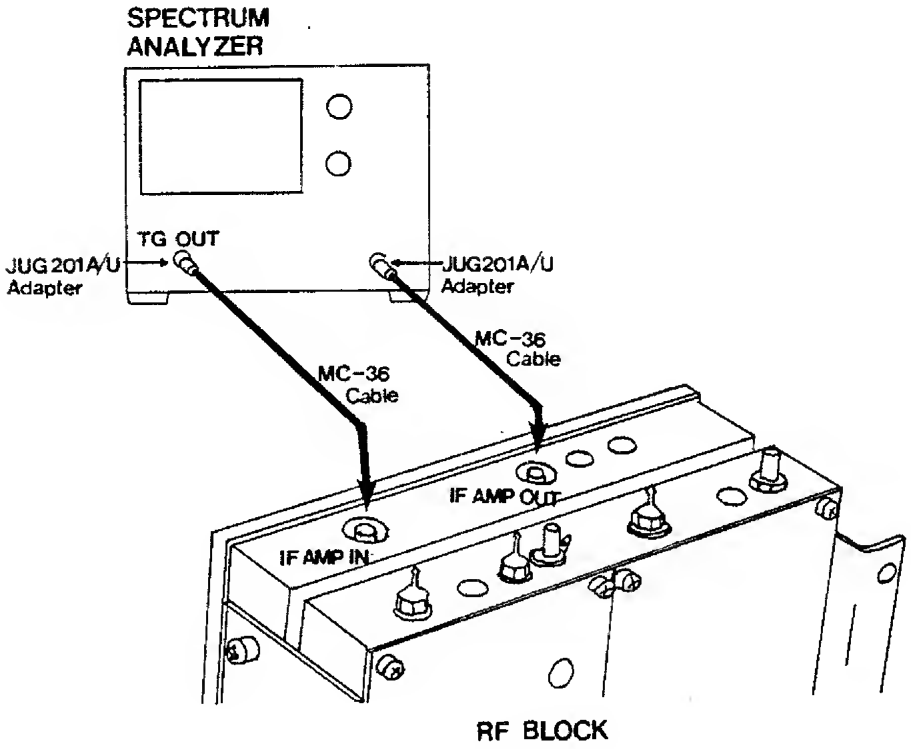


Figure 6 - 14 Setup for IF AMP Adjustment (1)

-50dBm IF AMP IN to IF OUT

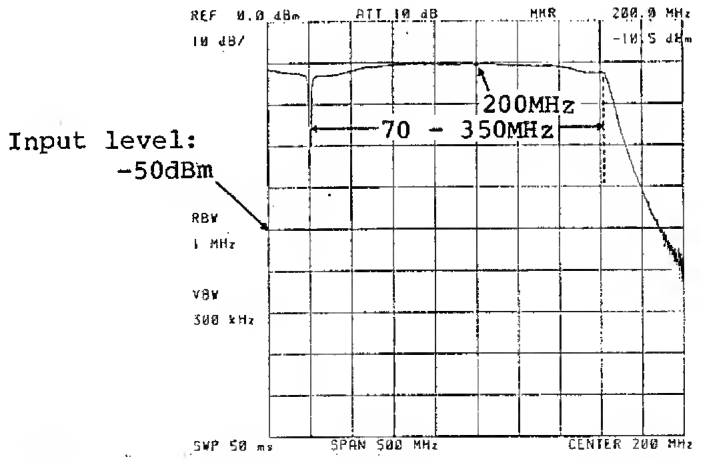


Figure 6 - 15 IF AMP Characteristics

⑤ Set up for IF AMP adjustment as shown in Figure 6-16.

⑥ Set the signal generator output for -20 dBm, then check that the digital voltmeter indicates approx. 0 V. Apply 0 dBm in the same way, then check that the digital voltmeter readout is approx. 2-3 V. (Set the R28 and R35 controls in the midrange)

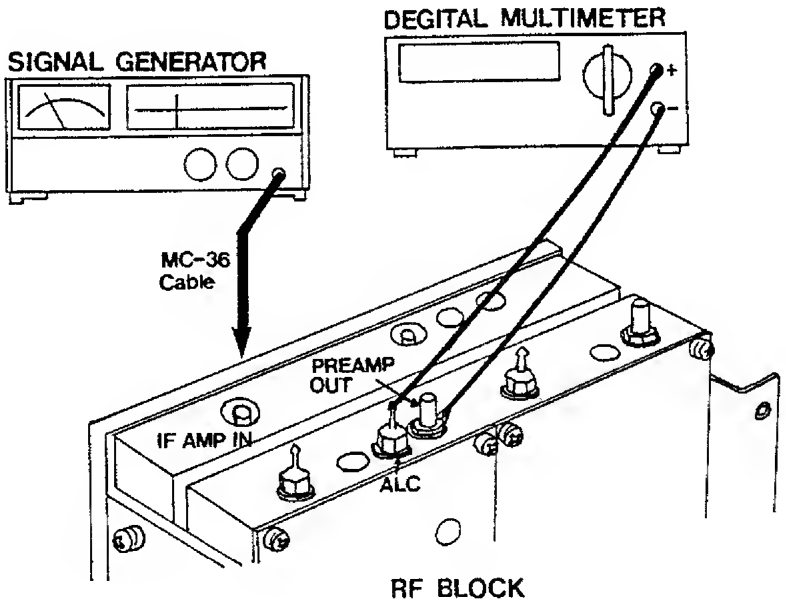


Figure 6 - 16 Setup for IF AMP Adjustment (2)

6.8.3 PREAMP (BLB-010909) Characteristics and Adjustment

Equipment to be used: Spectrum analyzer

(1) Remove the RF block as shown in Figure 6-10.

(2) Set up for PREAMP adjustment as shown in Figure 6-17. Connect the PREAMP OUT connector to the IF AMP IN connector with a cable (DCB-FF 1146 x 01). Connect the IF OUT connector to the spectrum analyzer input terminal and the RF input connector to the tracking generator output terminal with MC-02 cable via the JUG 201 A/U adapter.

(3) Set the output level of the tracking generator in the spectrum analyzer to -30 dBm. Then, check that a waveform as shown in Figure 6-18 is displayed on the CRT screen of the spectrum analyzer.

(4) Set the cut-off frequency to 350 MHz using the trimmer C25. The gain is 20 dB ±3 dBp-p. The frequency band is 70-350 MHz.

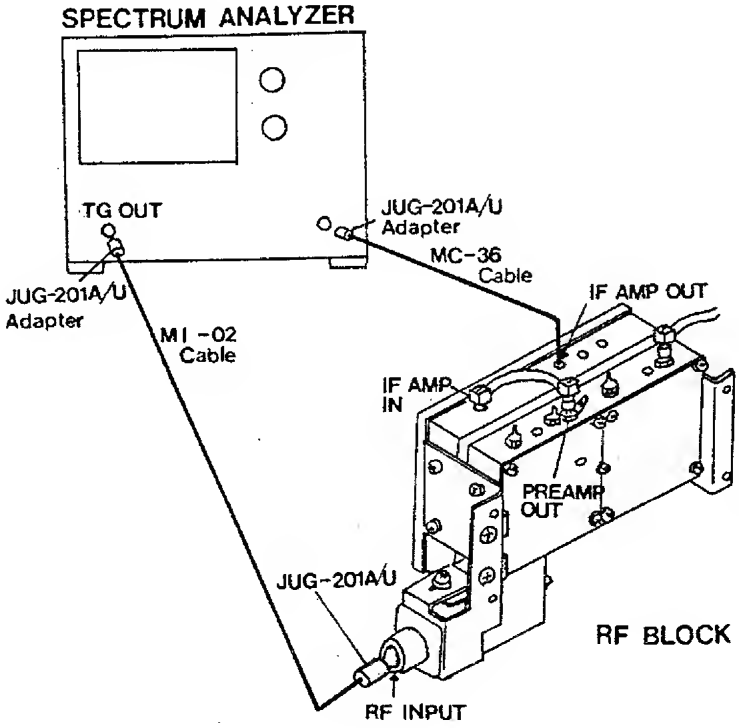


Figure 6 - 17 Setup for PREAMP adjustment

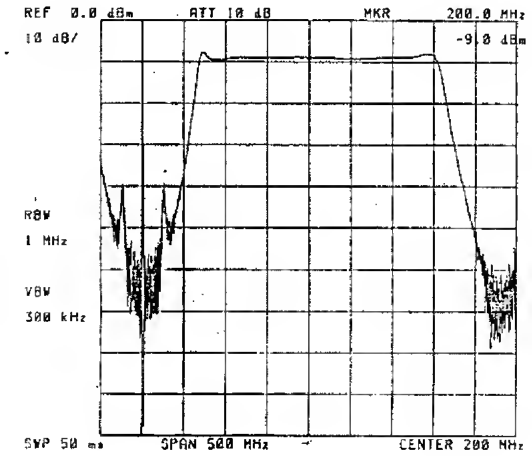


Figure 6 - 18 PREAMP characteristics (including the IF AMP and SAMPLER characteristics)

6.8.4 Overall Adjustment of RF Block

Equipment to be used: Spectrum analyzer

(1) PLL operation check and spurious response (Adjustment of R119 for LOCAL CONTROL(BGF-010894)

① In the reverse order of Figure 6-10, incorporate the RF block in the mainframe of the counter.

② Set up for PLL operation check as shown in Figure 6-19.

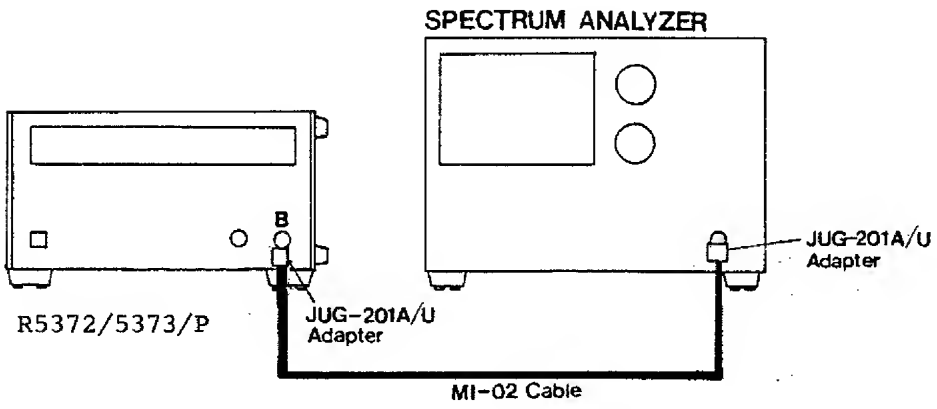


Figure 6 - 19 Setup for PLL operation check

③ Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Set the INPUT SELECT switch to B.
- Press the MANUAL, 1, 1, 0, 0, and ENTER switches in order.

④ Adjust R119 so that the 100 kHz spurious response is set to the lowest level (approx. 40-50 dB). (See Figure 6-20 and 6-21)

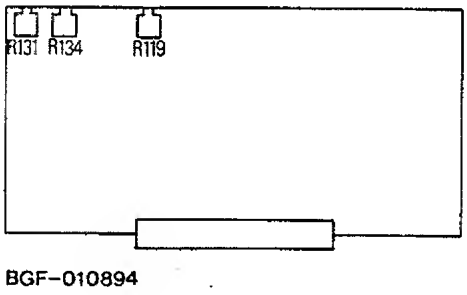


Figure 6 - 20 Location of R119, 131 and 134

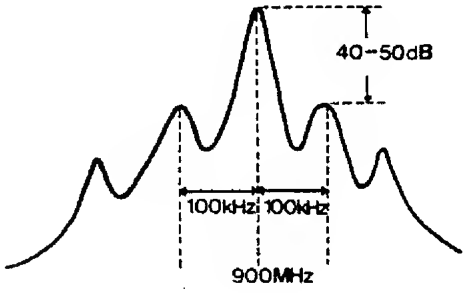


Figure 6 - 21 PLL Operation and Its Spurious Response Characteristics

(2) LIMITER check (Adjustment of R131 and R134 for LOCAL CONTROL (BGF-010894)

Equipment to be used: Oscilloscope

① In the reverse order of Figure 6-10, incorporate the RF block in the mainframe of the counter.

② Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Set the INPUT SELECT switch to B.
- Press the [MANUAL], [1], [0], [0], [0], and [ENTER] switches in order.

③ Connect the oscilloscope probe to the VC terminal. (See Figure 6-22)

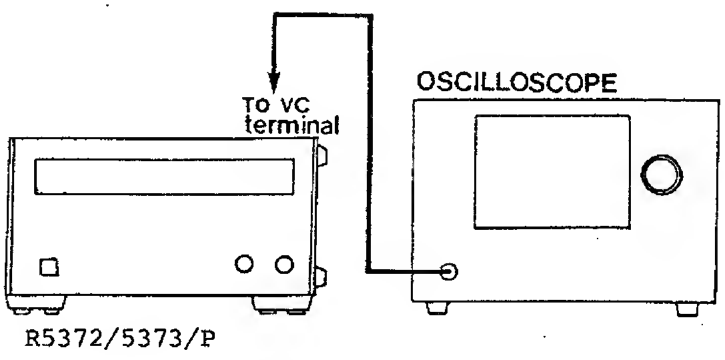


Figure 6 - 22 Setup for LIMITER check

④ Observing the waveform output from the VC terminal on the CRT display of the oscilloscope, measure the -DC voltage value. Assume the -DC voltage value to be A. (See Figure 6-23)

⑤ Set the key switches on the front panel of the counter as follows:
- Press the MASTER RESET switch.
- Set the INPUT SELECT switch to B.

⑥ Observing the waveform output from the VC terminal on the CRT display of the oscilloscope, adjust R134 to a waveform as shown in Figure 6-23.

⑦ Press the following key switches on the front panel of the counter.
- MANUAL, 1, 2, 0, 0, ENTER.

⑧ Observing the waveform output from the VC terminal on the CRT display of the oscilloscope, measure the +DC voltage value. Assume the +DC voltage value to be B. (See Figure 6-23)

⑨ Set the key switches on the front panel of the counter as follows:
- Press the MASTER RESET switch.
- Set the INPUT SELECT switch to B.

⑩ Observing the waveform output from the VC terminal on the CRT display of the oscilloscope, adjust R131 to a waveform as shown in Figure 6-23.

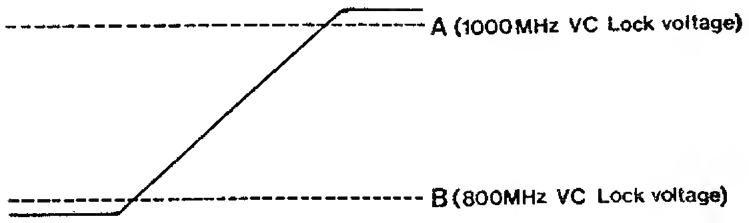


Figure 6 - 23 LIMITER Check

(3) LOCK check

Equipment to be used: Frequency counter
Oscilloscope

① Referring to Figure 6-10, incorporate RF block in the mainframe of the counter.

② Set up for LOCK check as shown in Figure 6-24.

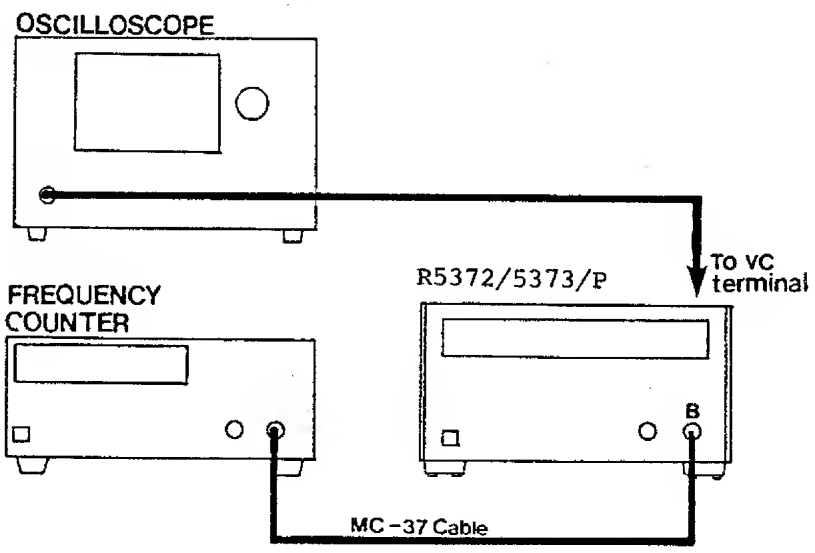


Figure 6 - 24 Setup for LOCK Check

③ Set the key switches on the front panel of the counter as follows:

- Set the POWER switch to ON.
- Set the INPUT SELECT switch to B.
- Set the following key switches, then check that their corresponding frequency values are displayed on the frequency counter readout as follows:

R5372/73/P key switches to be set	Frequency counter display
MANUAL 1 0 0 0 ENTER	800 MHz
MANUAL 1 0 5 0 ENTER	850 MHz
MANUAL 1 1 0 0 ENTER	900 MHz
MANUAL 1 1 5 0 ENTER	950 MHz
MANUAL 1 2 0 0 ENTER	1000 MHz

(4) Overall RF Block Check

Required equipment: Spectrum analyzer
Signal generator

① Connect the signal generator output to INPUT B connector of the counter. Switch on the counter, and set the signal generator output to 18 GHz and -20 dBm.

② Under the initial state of the counter, press the following keys sequentially:

③ Connect the IF AMP output to the spectrum analyzer input connector (see Figure 6-25). Check the signal response against that shown in Figure 6-26.

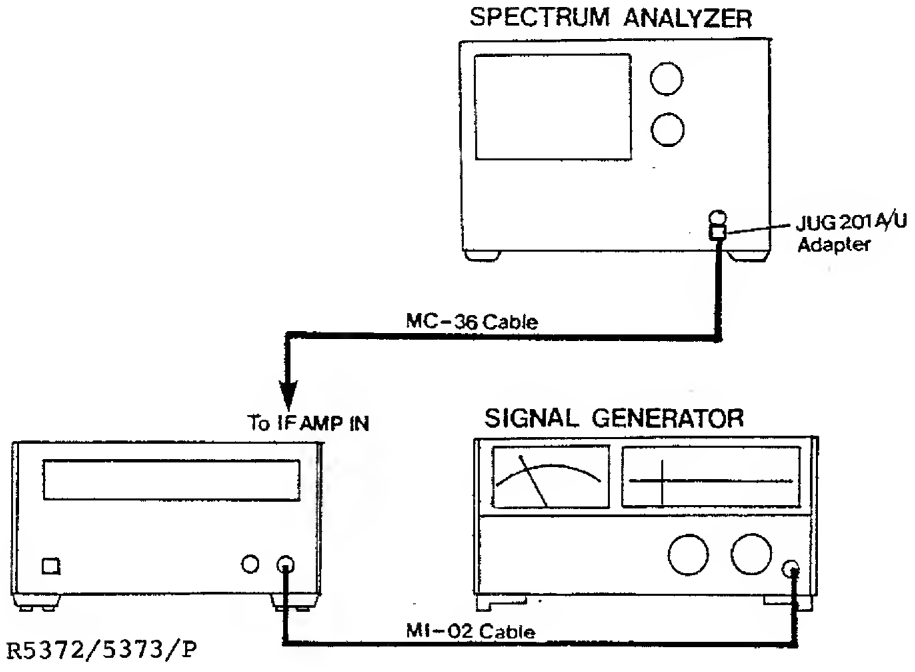


Figure 6 - 25 RF Section Test Setup

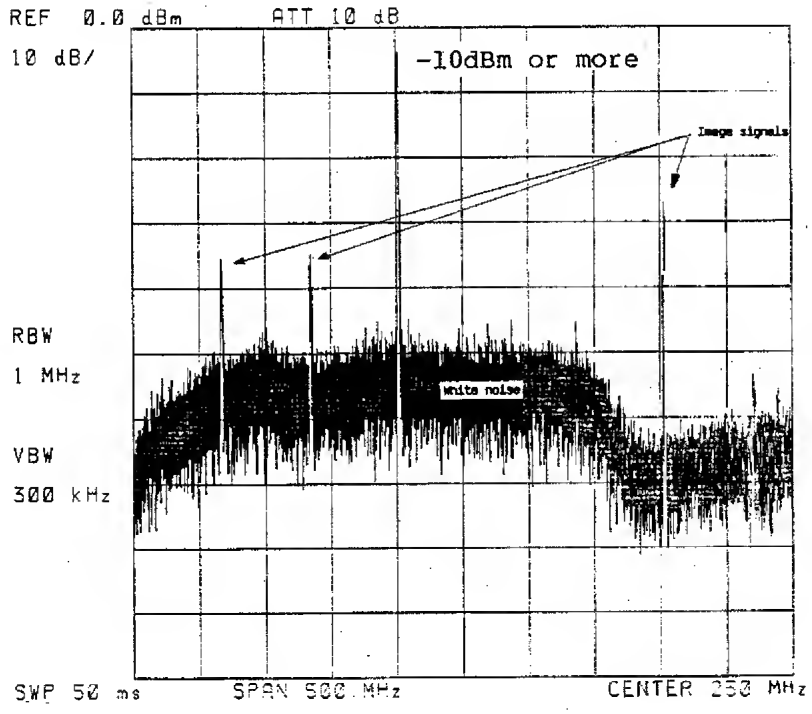


Figure 6 - 26 Output Level of IF AMP OUT Terminal

7. GPIB INTERFACE (OPTION 01)

R5372/5373/R5372P/5373P Microwave Frequency Counter incorporating option 01 can be connected to a general-purpose interface bus (GPIB) system for measurement which complies with IEEE Standard 488.
This section explains the specifications and functions of GPIB.

7.1 General Description of GPIB

The GPIB is an interface system that makes it possible to connect a controller or peripheral equipment to a measuring instrument using a simple cable (bus line). Compared to conventional interface systems, it can be used and extended with more ease and is electrically, mechanically and functionally compatible with other manufacturers' equipment, so that it is possible to construct a wide range of systems from relatively simple systems up to high-performance automatic measuring systems by using a single bus cable. When devices are connected to the bus line of a GPIB system, they must be assigned addresses. Such devices connected to the bus line can assume one or more of the three roles of controller, talker, and listener. During system operation, only one talker is allowed to transmit data to the bus line, whereas two or more listeners are allowed to receive the data. The controller specifies the talker and listener addresses and transfers data from the talker to the listener, or the controller itself (talker) may set measuring conditions for the listener. For interdevice data transfer, 8 data lines for bit-parallel byte-serial data transmission are used; they permit asynchronous bidirectional data transmissions. Because the system operates asynchronously, it allows both high- and low-speed devices to be arbitrarily interconnected with it. The data (messages) transmitted between devices may contain measurement data, measuring conditions (programs), and commands; they are represented in ASCII code.

In addition to the foregoing 8 data lines, the GPIB includes 3 handshake lines used to control asynchronous data transfers between devices and 5 control lines used to control the flow of data on the bus.

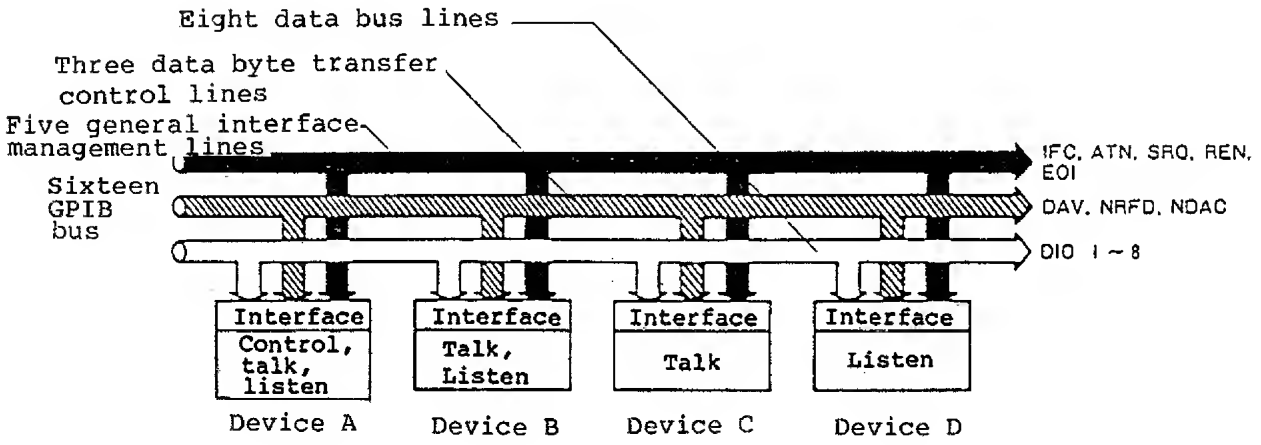


Figure 7 - 1 General Structure of GPIB

- The handshake lines convey the following signals:

  DAV (data valid) : Indicates that data is valid.

  NRFD (not ready for data): Indicates that the device is not ready to receive data.

  NDAC (not data accepted) : Indicates that data reception is not terminated.

- The control lines convey the following signals:

  ATN (attention) : Used to identify a signal on a data line as an address, a command, or other information.

  IFC (interface clear) : Used to clear the interface.

  EOI (end or identify) : Used when information transfer is terminated.

  SRQ (service request) : Used when a device requests the service to controller.

  REN (remote enable) : Used to remote-control of devices with remote control capability.

7.2 Specifications

7.2.1 GPIB Specifications

Standard: IEEE Standard 488-1978

Code : ASCII

Logic levels : Logic 0 = high state = +2.4 V or more
Logic 1 = low state = +0.4 V or less

Signal line termination: 16 bus lines are terminated as shown in Figure 7-2.

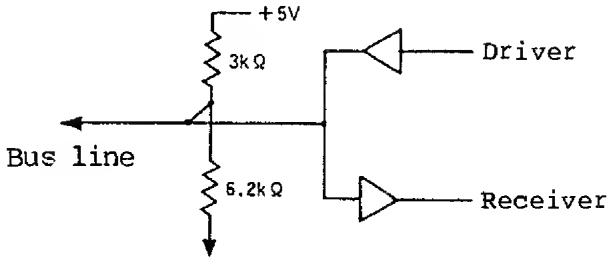


Figure 7 - 2 Signal Line Termination

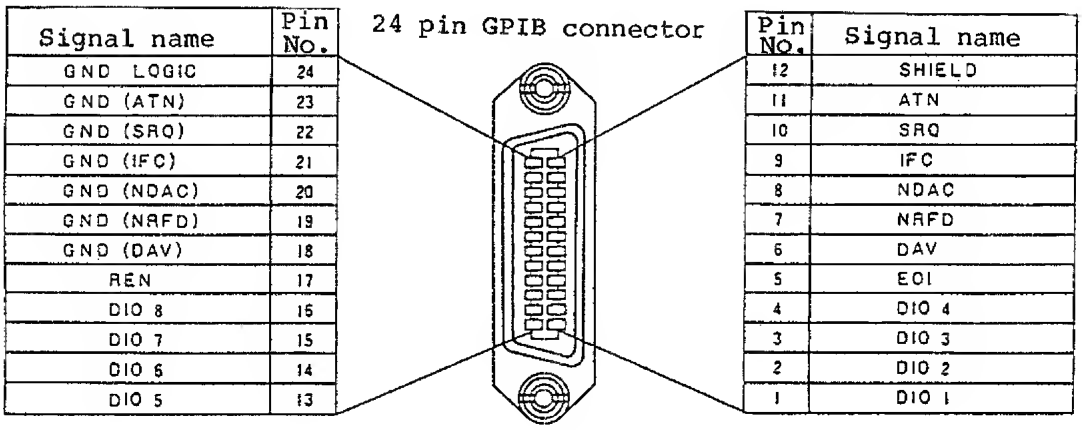
Driver specifications : Tristate type
Low output voltage: +0.4 V or less, 48 mA
High output voltage: +2.4 V or more, -5.2 mA

Receiver specifications: +0.6 V or less: Low state
+2.0 V or more: High state

Bus cable length : Total bus-cable length must be (number of devices connected to bus) x 2 m or less, not exceeding 20 m.

Address designation : 31 types of talk/listen addresses may be arbitrarily set using the address selection switches on the rear panel.

Connector type : 24-pin GPIB connector
57-20240-D35A (equivalent to Amphenol connector)



Signal name	Pin No.
GND LOGIC	24
GND (ATN)	23
GND (SRQ)	22
GND (IFC)	21
GND (NDAC)	20
GND (NRFD)	19
GND (DAV)	18
REN	17
DIO 8	16
DIO 7	15
DIO 6	14
DIO 5	13

Pin No.	Signal name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO 4
3	DIO 3
2	DIO 2
1	DIO 1

Figure 7 - 3 GPIB Connector Pin Assignment

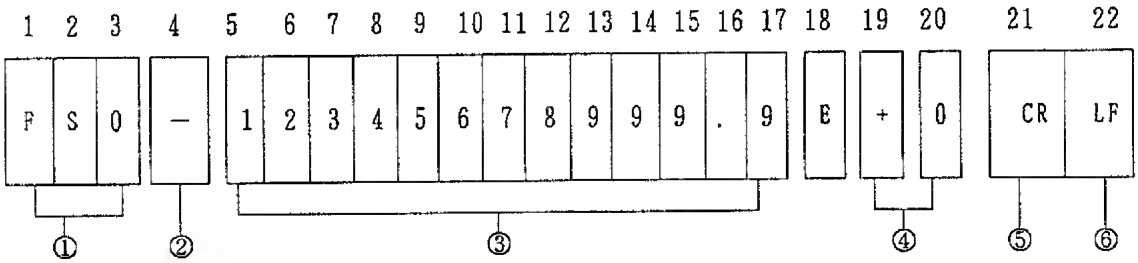
7.2.2 Interface Functions

Table 7 - 1 Interface Functions

Code	Capabilities/meaning
SH1	Source handshake
AH1	Accepter handshake
T5	Basic talker, serial poll, talk-only mode, unaddressed to talk if addressed to listen
L4	Basic listener, unadressed to listen if addressed to talk
SR1	Service request
RL1	Remote/local changeover function
PP0	No parallel poll function.
DC1	Device clear (SDC and DCL commands are usable.)
DT1	Device trigger (GET command is usable.)
C0	No controller function
E2	Tristate bus driver is used.

7.2.3 Talker Format (Data Output Format)

The general format used for data transmission by the talker is as follows:



① Header part

Header 1 ─ F: Frequency (in Hz)
S: Time (in seconds)
P: PPM
T: Totalization

Header 2 ─ S: Offset, division, multiplication, or transitional difference
␣: Above settings are off.

Header 3 ─ O: Over] Priority 1
H: High] Priority 2
L: Low
P: Pass
A: Average value] Priority 3
X: Maximum value (MAX)
N: Minimum value (MIN)
D: Fluctuation width (ΔF)
S: Standard deviation (σ)
␣: Above settings are off.

␣ : Space

NOTE

If two or more conditions occur at the same time, the command is set in the order of priority and the others of priority are ignored.

② Data sign

Space: plus

\- : minus

③ Data (12 digits) + decimal point (1 digit)

Zero (not space) is sent for the leading zero (zero blanking).

④ Exponent part code

+0	10^{0}
+3	10^{3}
+6	10^{6}
+9	10^{9}
-3	10^{-3}
-6	10^{-6}

⑤ Carriage return

⑥ Line feed

NOTE

If the address switch HEADER on the rear panel is set to 0, three space code characters are output for the header part. Normally, the delimiter is CRLF & EOI, but it can be changed by issuing a command from the controller.

The output format is shown in Table 7-2 with the changing the resolution (gate time) during measurement of a continuous wave at INPUT B.

Table 7 - 2 Correspondence Between Resolutions and Output Formats

Resolution	FSO	-12345678999.9	E+0	CRLF
10 MHz	F␣␣	␣0000000012.34	E+9	CRLF
1 MHz	F␣␣	␣000000012345.	E+6	CRLF
100 kHz	F␣␣	␣00000012345.6	E+6	CRLF
10 kHz	F␣␣	␣0000012345.67	E+6	CRLF
1 kHz	F␣␣	␣000012345678.	E+3	CRLF
100 Hz	F␣␣	␣00012345678.9	E+3	CRLF
10 Hz	F␣␣	␣0012345678.99	E+3	CRLF
1 Hz	F␣␣	␣012345678999.	E+0	CRLF
0.1 Hz	F␣␣	␣12345678999.9	E+0	CRLF

7.2.4 Listener Format (Program Codes)

(1) Function setting

Code	Setting
F0	INPUT A
F1	INPUT B
F2	INPUT A: 10 MHz to 550 MHz, 50 Ω
F3	INPUT A: 10 mHz to 10 MHz, 1 MΩ
F4	Totalization measurement (TOT A)
F5	Pulse width measurement (PW)
F6	Stepping up resolution (RESOLUTION UP)
F7	Stepping down resolution (RESOLUTION DOWN)
F8	ENTER
F9	Clear data (CLR-KB)

NOTE

If ENTER (code F8) is set to input feed data, it takes approximately 10 ms before normal operation can be resumed; wait for approximately 10 ms before executing the next operation.

(2) Setting resolution and number of display digits

Code	Resolution (for INPUT B, or INPUT A in 10 MHz to 550 MHz band)	Number of display digits (for INPUT A in 10 mHz to 10 MHz band)	
		MSD 1 to 2	MSD 3 to 9
G0	10 MHz		
G1	1 MHz		
G2	100 kHz		
G3	10 kHz		
G4	1 kHz	6	5
G5	100 Hz	7	6
G6	10 Hz	8	7
G7	1 Hz	9	8
G8	0.1 Hz		

* The minimum value that can be displayed is 0.1 mHz. If the input frequency is very low, its measurement cannot fill the specified number of display digits.

(3) Setting of offsetting, division, multiplication, and so forth

Code	Setting
00	Offsetting (OFS)
01	Division (÷)
02	Multiplication (x)
03	Parts per million (PPM)
04	Comparison (COMP)
05	Acquisition (ACQ)
06	Spectrum analyzer designation (TR)
07	Transitional difference
08	Measurement of INPUT A
09	Measurement of INPUT B

(4) Statistical computation and function setting

Code	Setting
A0	Average value (statistical computation) on
A1	Average value (statistical computation) off
A2	Standard deviation (σ)
A3	Maximum value (MAX)
A4	Minimum value (MIN)
A5	Fluctuation width (ΔF)
A6	ATT 0 dB (ANS OFF)
A7	ATT 20 dB (ANS ON)
A8	RF ATT AUTO
A9	RF ATT 20 dB

(5) Manual measurement setting

Code	Setting
M0	Manual measurement on
M1	Manual measurement off

(6) Measuring condition and function setting

Code	Setting
S0	Service request (SRQ) on
S1	Service request (SRQ) off
S2	HOLD reset
S3	HOLD set
S4	RESET (TOT A ON/OFF)
S5	MASTER RESET
S6	CHECK

S0 mode: SRQ message is sent when the device is not addressed as the talker; the data is sent when the device is addressed as the talker at measurement end (SRQ is not output).

S1 mode: No SRQ is output in this mode.

(7) Delimiter setting

Code	Setting
DL0	CRLF & EOI
DL1	LF
DL2	EOI

(8) Others

Code	Setting
SH	SHIFT key
E	Measurement start
C	Device clear
-	Negative polarity (polarity reversal)
.	Decimal point
0 to 9	Numericals

GPIB command	Setting
GET	Measurement start command
DCL	Device clear
SDC	Device clear
REMOTE	Remote
LOCAL	Local

(9) Initialization

Reception of a universal command "DCL", an address specification command "SDC", or a program code "C" from the controller causes the following settings to be made (same as caused by MASTER RESET):

Item	Initial setting
Input	B (F1)
Resolution	100 Hz (G5)
SRQ output mode	No output (S1)
Sample rate	HOLD release (S2)
Computation function	All OFF
INPUT B	AUTO operation

(10) Service request

Cause of service request:

Generation of data as a result of measurement.

Status byte:

When a service request is made, the instrument transmits the following status byte to the controller in response to serial polling made by the controller.

(MSB) D8	D7	D6	D5	D4	D3	D2	D1 (LSB)
0	1	0	0	0	0	0	1

D1 = Bit "1" indicates termination of measurement.

CAUTION

In the S1 mode (SRQ is not output), bit D7 of this instrument does not become "1".

7.3 Use of GPIB

7.3.1 Device Connections

The GPIB system incorporates two or more devices; take the following points into consideration in preparing the system:

(1) Referring to the instruction manual for individual devices to be connected such as this instrument, controller, and various peripheral equipment, ascertain their status (prepared conditions) and operations.

(2) The cables to connect measuring instruments and the bus cables to connect the controller and other devices should be as short as possible. The bus cables should not be longer than the maximum length allowable; the total bus-cable length must be (number of devices connected to bus) x 2 m or less, not exceeding 20 m.
The R5372/73/5372P/R5373P microwave frequency counters comply with FCC radiation regulation. Use of the following connecting cables is suggested to construct a GPIB system with the microwave frequency counter.

Table 7 - 3 Standard Bus Cables (To be purchased separately)

Length	Stock No.
0.5 m	408JE-1P5
1 m	408JE-101
2 m	408JE-102
4 m	408JE-104

(3) Bus cable connectors are "piggyback" types with both plug and socket sides provided, thereby enabling connectors to be stacked. Do not stack more than two connectors together. The connectors used must be fixed tightly with screws.

(4) Before powering the individual devices connected to the bus, check their power requirements; ground condition; and, if necessary, setting conditions. To operate the system, every device connected to the bus must be powered; otherwise, overall system operation cannot be assured.

(5) When connecting or disconnecting a bus cable, be sure to unplug the power cable from the power outlet beforehand.

7.3.2 Panel Description

See Figure 7-4.

Front panel

① REMOTE lamp

This lamp remains on while the instrument is controlled by commands issued from the controller; in this state, the key switch settings on the front panel are ignored.

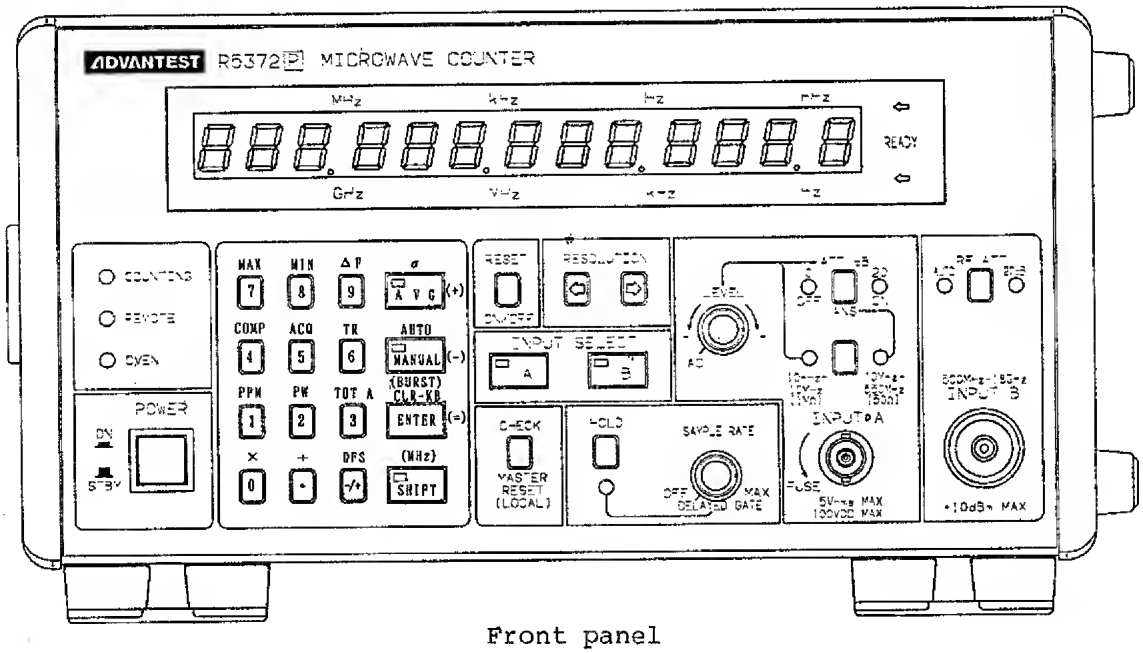
Rear panel

② ADDRESS switch

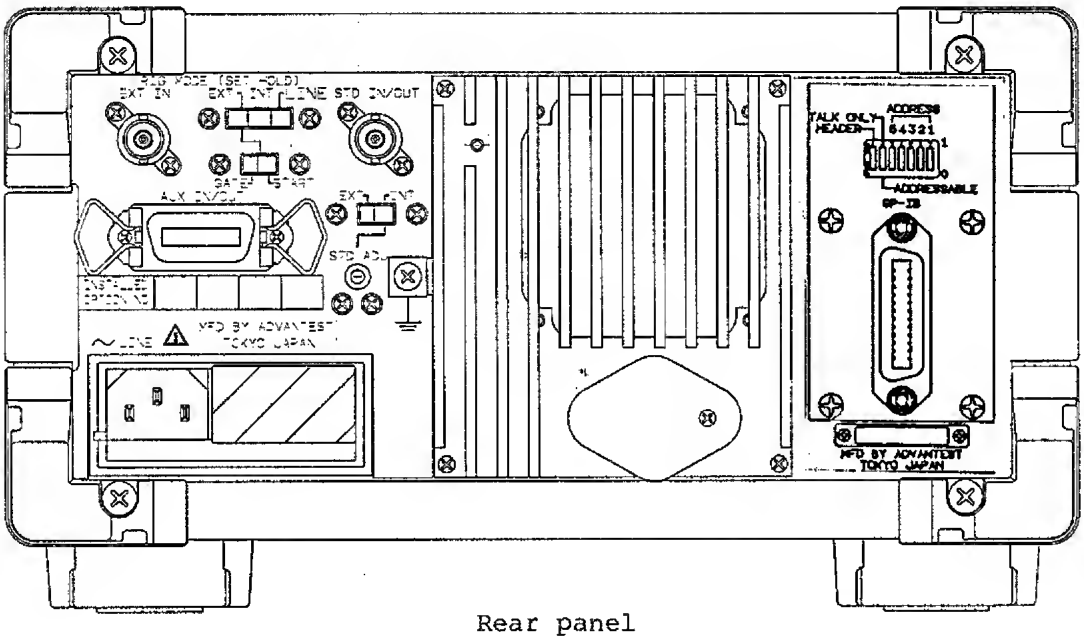
This is a DIP switch used to set the instrument address (talker or listener address) on the bus. Bits 1 to 5 are used to set the address code of the instrument. Setting bit 6 to ADDRESSABLE enables the controller to specify an address; setting it to TALK ONLY causes the unit to be fixed as the talker with the settings of ADDRESS 1 to 5 to be ignored. Setting bit 7 to 1 causes the header to be transmitted together with data; setting it to 0 causes the header to be converted into space codes.

③ GPIB connector

This is a 24-pin connector used to connect a bus cable. It is of the piggyback type so that two connectors can be stacked to connect two standard bus cables with one connector placed over the other. Do not stack more than two connectors.



Front panel



Rear panel

Figure 7 - 4 Front and Rear Panels

7.3.3 Address Setting

To set the talk address and listen address of this instrument in a GPIB system, use the ADDRESS switch on the rear panel. It is a 7-bit (7-position) DIP switch. The five bits (positions) of ADDRESS 1 to 5 are used to set one of the 31 types of addresses.
In Figure 7-5, for example, they have been set to "00100", meaning "4" in decimal notation. The same setting in ASCII code represents the address of D for the talker or the address of "$" for the listener as listed in [Table 7-4]. Setting bit 6 to ADDRESSABLE allows a response to be made only when the address specified by the controller coincides with that set on this switch (ADDRESS 1 to 5). When it is set to TALK ONLY, the instrument is fixed as the talker with the address set on this switch ignored. When data is transmitted with bit 7 of this switch set to 1, a 3-character header is also transmitted. If, at that time, bit 7 is 0, the three header characters are converted into space codes.

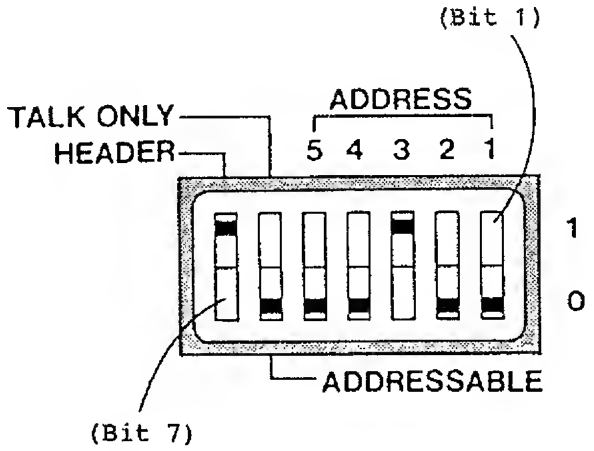


Figure 7 - 5 ADDRESS Switch

Table 7 - 4 Address Code

ASCII code character		ADDRESS switch					Decimal code
LISTEN	TALK	A5	A4	A3	A2	A1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

7.4 General Precautions

(1) Use of ONLY mode

To use the instrument in the only mode, set the ADDRESS switch on the rear panel to TALK ONLY and set the address mode of the device to communicate with to only. In the only mode, do not use the controller simultaneously with the instrument, commands issued from the controller to the unit in the ONLY mode are ignored and correct operation is not ensured in such a case.

(2) Power failure during operation

If a power failure (including an instantaneous one) occurs during operation of a GPIB system incorporating this instrument, normal system operation is not ensured after power recovery. Normally, when recovery is made from a power failure, the interface is initialized. If a power failure occurs, care should also be taken to other devices in the system.

(3) Interrupt by controller during data transfer between devices

The GPIB system permits data transfer between devices other than the controller. If the controller makes an interrupt during data transfer between devices (during handshaking) to change into the serial poll mode or to add a listener, interdevice data transfer is stopped to give priority to the controller's interrupt. Data transfer is resumed after completion of interrupt processing.

Generally, to make data transfer between devices, arrange the program so that the state of interdevice data transfer can be recognized by the controller.

(4) Changing ADDRESS switch setting

If the ADDRESS switch (bits 1 to 5) setting is changed during operation, the change is ignored and the previous setting remains valid. Therefore, if it is necessary to set a new address, set it before powering the instrument. If it becomes necessary to change the ADDRESS switch (bits 1 to 5) setting after starting operation, switch the instrument off and switch it on again after changing the setting. The same also applies to the TALK ONLY-addressable switch (bit 6). The HEADER switch (bit 7) setting can be changed during operation.

(5) General operation flowchart (for data transmission)

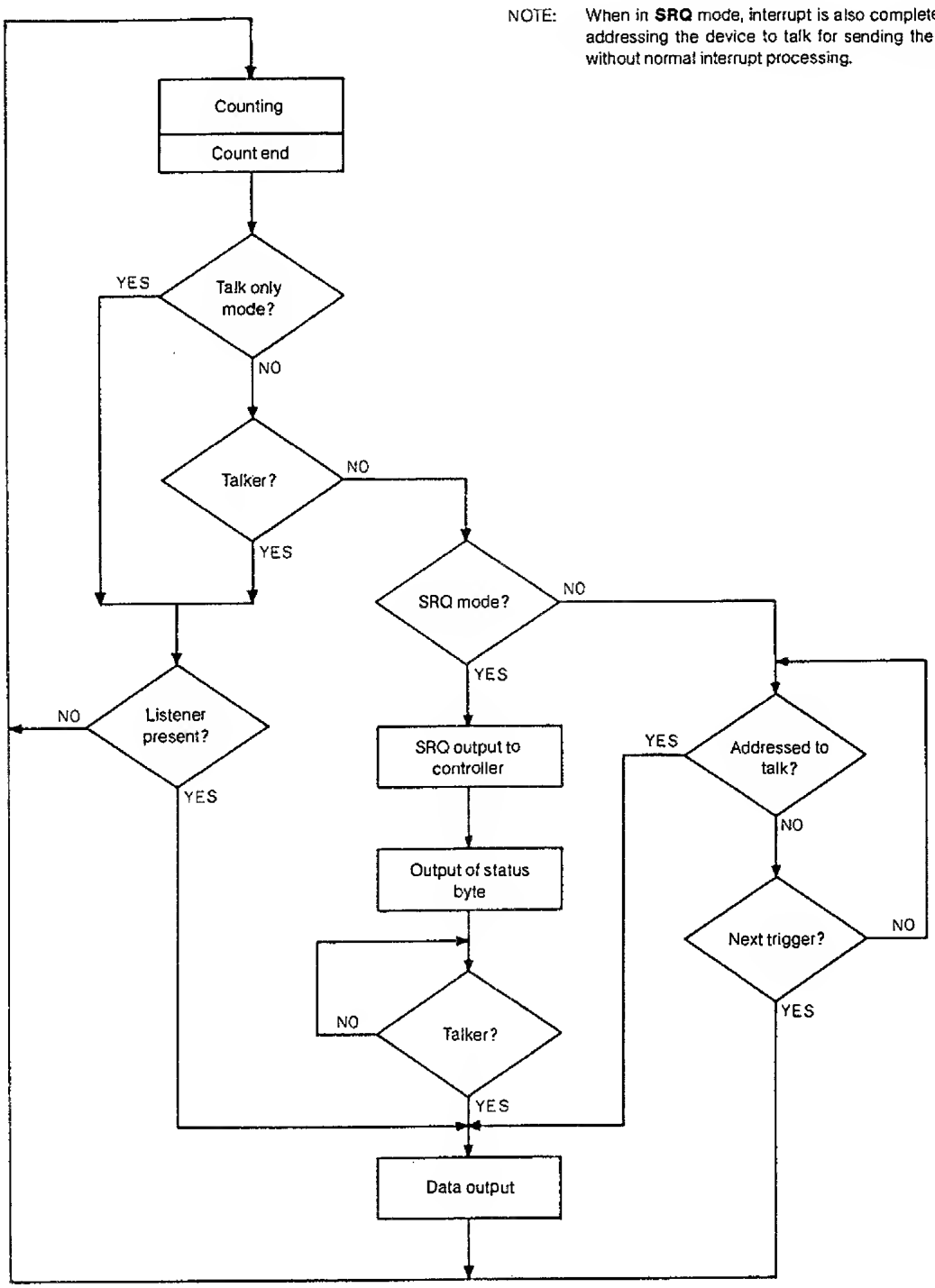
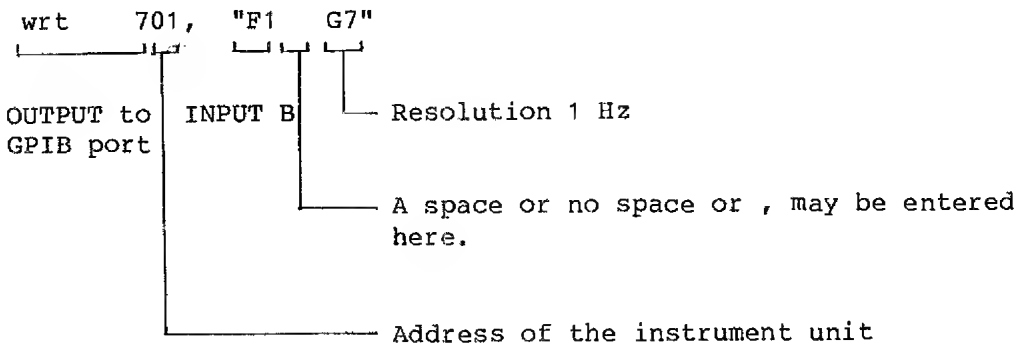


Figure 7 - 6 General Operation Flowchart

7.5 Programming

Function and range settings are made in order complying with the codes transmitted from the controller. Normally, as key switches on the front panel are pressed, the controller transmits the corresponding codes and numbers. For example, if INPUT A and a resolution of 10 Hz are specified, the controller transmits the corresponding codes "F0" and "G6" respectively. Some examples of programming made using the HP-9825A are shown in the following:

(1) Specifying input B and setting resolution to 1 Hz.



(2) Setting the HOLD state for INPUT B, setting the resolution to 1 Hz, making measurement by properly triggering on the signal, and storing the measurement into register A.

```
wrt 701, "F1S3G7"
      :
      :
      :
trg 701
red 701, A
      :
      :
      :
```

(3) Setting the offset to 500 MHz to be added to the measurement of INPUT A.

```
wrt 701, "F000500F8"
                 └── Value in MHz
```

(4) Setting the offset to 3.3 MHz to be subtracted from the measurement of INPUT B.

```
wrt 701, "O0-3.3F8"
```

Note: The operation of ENTER code "F8" is completed approximately 10 ms after it is entered. In programming, therefore, insert the wait time after it before entering the next operation code as follows:

```
wrt 701, "O0-3.3F8"
wait 10
wrt 701, "G8" (or wrt 701, "G8O0-3.3F8")
```

(5) Observing the drift from the current frequency at INPUT B.

```
wrt 701, "O0O9-F8"
or
wrt 701, "O0SHF1-F8"
```

(6) Setting the comparator high level and low level to 2000 MHz and 1999 MHz respectively.

```
wrt 701, "O42000F8"
wait 10
wrt 701, "1999F8"
```

Note: In this program, the comparator is set and the high level data is input, then, after a wait time of 10 ms, the low level data is input.

(7) Setting 10 GHz for manual measurement

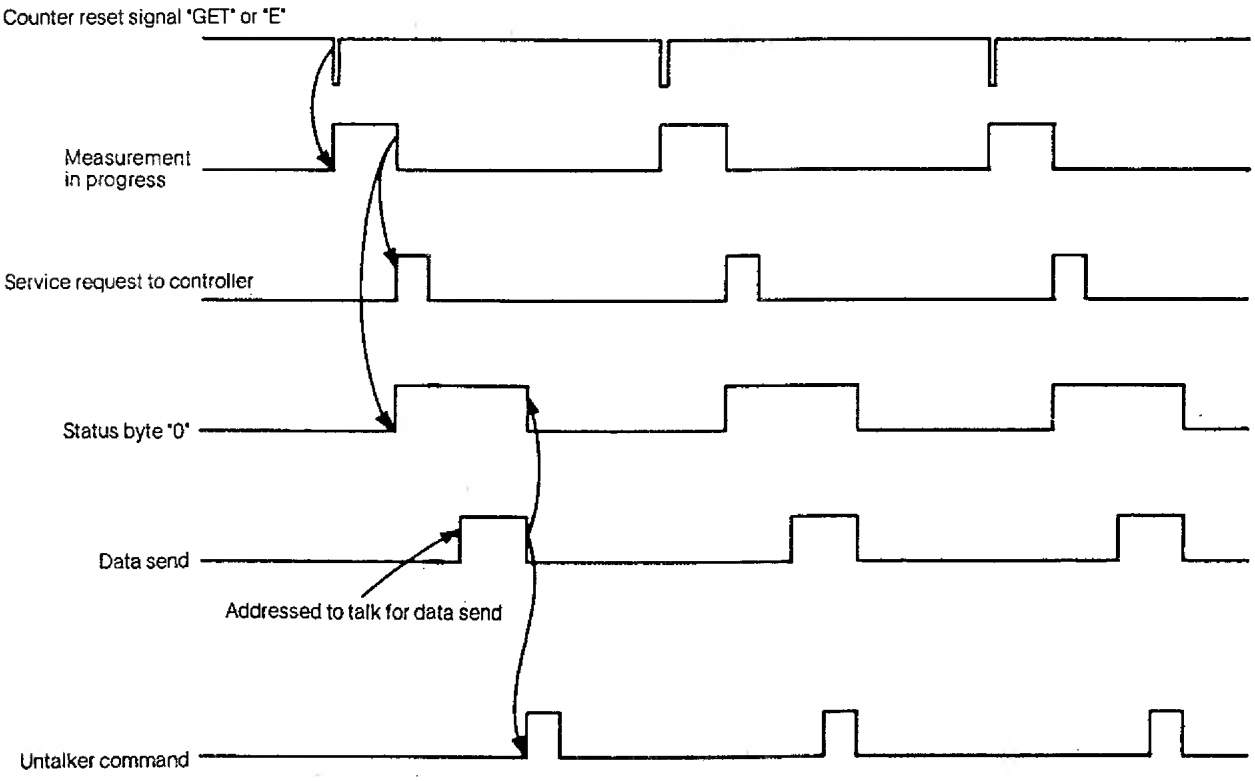
```
wrt 701, "M010000F8"
```

(8) Service request and subsequent operation

See Figure 7-7.

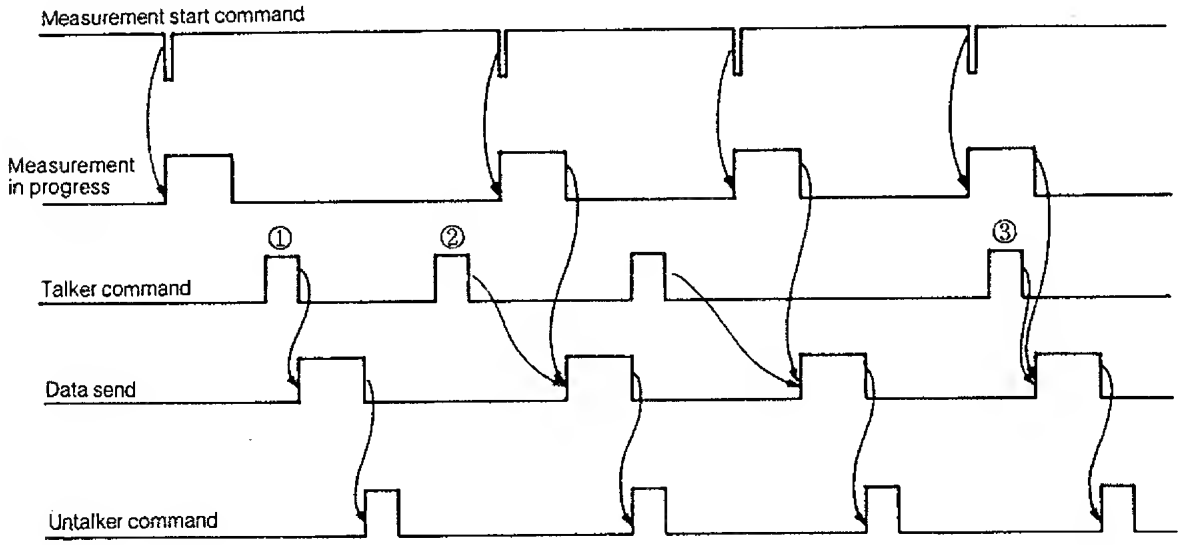
(9) Timing of data transmission upon being addressed to talk

Figure 7-8 shows the timing of data transmission made following a talker designation. If this instrument is addressed as the talker, data can be transmitted upon termination of measurement or only once after termination of measurement. (If a "GET" or "E" code is issued as the measurement starting command, no untalker command is required. If the instrument is addressed to listen, it is unaddressed to talk.) See Figure 7-8.



(The counter is unaddressed to talk by being addressed to listen with "GET" or "E" command or sends out untalker command.)

Figure 7 - 7 Service Request and Subsequent Operation



① The instrument is addressed to talk after termination of measurement (Data is output immediately.)

② The instrument is addressed to talk after data is sent out (Data is output after termination of the next measurement.)

③ The instrument is addressed to talk during measurement (Data is output after termination of measurement.)

Figure 7 - 8 Timing of Data Transmission When Addressed to Talk

7.6 Program Examples

(1) Selecting INPUT B with the resolution of 10 Hz in HOLD mode and collecting data by issuing a trigger every 10 seconds

a. Programming using HP-9825A

- Program

```
0: clr 701
1: wrt 701,"F1G6
 S3"
2: trg 701
3: red 701,A
4: prt A
5: wait 10000
6: sto 2
*8143
```

0 : Clears the instrument
1 : Selects INPUT B, sets the resolution to 10 Hz, and sets the holding state.
2 : Trigger (measurement starting command)
3 : Reads data.
4 : Prints out the data.
5 : Wait time of 10 s.
6 : Returns to line 2.

- Data

```
12345333790.0
12345348430.0
12345367020.0
12345396340.0
12345418190.0
12345439150.0
12345462650.0
12345489350.0
```

b. Programming made using HP-85

- Program

```
 5 CLEAR 701
10 OUTPUT 701 ;"F1G6S3"
20 TRIGGER 701
30 ENTER 701 ; A
40 PRINT A
50 WAIT 10000
60 GOTO 20
70 END
```

5 : Clears the instrument.
10: Selects INPUT B, sets the resolution to 10 Hz, and sets the holding state.
20: Trigger (measurement starting command)
30: Reads data.
40: Prints out the data.
50: Wait time of 10 s.
60: Returns to line 20.

● Data

```
1234586095O
1234586262O
1234585732O
1234586650O
1234586098O
1234586548O
1234586408O
```

(2) Printing out data in the designated format

a. Programming made using HP-9825A

● Program

```
0: dim A$[30]
1: clr 701
2: wrt 701,"F1S3
 G6"
3: trg 701
4: red 701,A$
5: prt A$
6: wait 10000
7: sto 3
#4239
```

0 : Defines the dimension (to be not less than the number of input bytes).

1 : Clears the instrument.

2 : Selects INPUT B, sets the resolution to 10 Hz, and sets the holding state.

3 : Trigger (measurement starting command).

4 : Reads data (input as a character string).

5 : Prints out the data.

6 : Wait time of 10 s.

7 : Returns to line 3.

● Data

```
F   0012346092.2
9E+3
F   0012346105.6
0E+3
F   0012346124.3
7E+3
F   0012346145.3
5E+3
F   0012346163.5
6E+3
```

b. Programming made using HP-85a.

o Program

```
10 DIM A$[30]
20 CLEAR 701
30 OUTPUT 701 ;"F1S3G6"
40 TRIGGER 701
50 ENTER 701 ; A$
60 PRINT A$
70 WAIT 10000
80 GOTO 40
90 END
```

10: Defines the dimension (to be not less than the number of input bytes).

20: Clears the instrument

30: Selects INPUT B, sets the resolution to 10 Hz, and sets the holding state.

40: Trigger (measurement starting command).

50: Reads data (input as a character string).

60: Prints out the data.

70: Wait time of 10 s.

80: Returns to line 40.

o Data

```
F    0012345999.58E+3
F    0012346000.31E+3
F    0012345999.34E+3
F    0012346007.62E+3
F    0012345997.70E+3
F    0012346003.97E+3
F    0012346006.20E+3
F    0012346006.05E+3
```

(3) Reading data every 10 s while keeping the instrument in free-run state, and printing out the data

a. Programming made using HP-9825A

● Program

```
0: rem 7
1: wrt 701,"CF1G
 7023F8"
2: wait 10
3: red 701,A
4: prt A
5: cmd 7,"_"
6: wait 10000
7: sto 3
*31944
```

0 : Turns the remote line true.

1 : Clears the instrument, selects INPUT B, sets the resolution to 1 Hz, and sets multiplication x3 to be applied to the measurement.

2 : Enters a wait time of 10 ms needed for the ENTER (F8) command.

3 : Reads data.

4 : Prints out the data.

5 : Untalker designation to cancel the previous talker designation.

6 : Wait time of 10 s.

7 : Returns to line 3.

● Data

```
37037990676.0
37037975445.0
37037964972.0
37037983734.0
37037976876.0
37037967963.0
37037976768.0
37037989470.0
```

b. Programming made using HP-85

● Program

```
10 REMOTE 7
20 OUTPUT 701 ;"CF1G7023F8"
30 WAIT 10
40 ENTER 701 ; A
50 PRINT A
60 SEND 7 ; UNT
70 WAIT 10000
80 GOTO 40
90 END
```

10: Turns the remote line true.

20: Clears the instrument, selects INPUT B, sets the resolution to 1 Hz, and sets multiplication x3 to be applied to the measurement.

30: Enters a wait time of 10 ms needed for the ENTER (F8) command.

40: Reads data.

50: Prints out the data.

60: Untalker designation to cancel the previous talker designation.

70: Wait time of 10 s.

80: Returns to line 40.

● Data

```
 37038013095
 37038039120
 37038023532
 37038009318
 37038005919
 37038005952
 37038026430
```

(4) Measuring (INPUT A + INPUT B) every 10 s and printing out the measurement

a. Programming made using HP-9825A

• Program

```
0: clr 701
1: wrt 701,"F1G6
 S3Q0F0F8"
2: wait 10
3: trg 701
4: red 701,A
5: prt A
6: wait 10000
7: sto 3
*28395
```

0 : Clears the instrument.

1 : Selects INPUT B, sets the resolution to 10 Hz, sets the holding state, sets offset, and selects INPUT A.

2 : Enters a wait time of 10 ms needed for the ENTER (F8) command.

3 : Trigger (measurement starting command).

4 : Reads data.

5 : Prints out the data.

6 : Wait time of 10 s.

7 : Returns to line 3.

• Data

```
12846886690.0
12846896100.0
12846926360.0
12846939140.0
12846946730.0
12846967230.0
12846995150.0
12847012390.0
```

b. Programming made using HP-85

● Program

```
10 CLEAR 701
20 OUTPUT 701 ;"F1G6S300F0F8"
30 WAIT 10
40 TRIGGER 701
50 ENTER 701 ; A
60 PRINT A
70 WAIT 10000
80 GOTO 40
90 END
```

10: Clears the instrument.

20: Selects INPUT B, sets the resolution to 10 Hz, sets the holding state, sets offset, and selects INPUT A..

30: Enters a wait time of 10 ms needed for the ENTER (F8) command.

40: Trigger (measurement starting command).

50: Reads data.

60: Prints out the data.

70: Wait time of 10 s.

80: Returns to line 40.

o Data

● Data

```
 12845987480
 12845986520
 12845992090
 12845990970
 12845993710
 12845992040
 12845990040
```

(5) Setting SO mode and making measurement by issuing a trigger from the controller when required

The controller may be engaged in a different operation until measurement is completed. Upon completion of measurement, the instrument issues a service request. The controller may restart the interrupted operation after reading data. The program example shown here is based on the assumption that devices other than this instrument do not make a service request.

- Program

```
0: rem 7
1: clr 701
2: wrt 701,"F1G6S0S300-1000F8"
3: oni 7,"SRQ"
4: "MAIN ROUTINE":
5: "WAIT":eir 7,128
6: for I=1 to 2000
7: dsp I
8: next I
9: trg 701
10: gto "WAIT"
11: "SRQ":rds(701)→S
12: wrt 6,"STATUS = ",S
13: red 701,A
14: wrt 6,"Freq. =",A," Hz"
15: iret
16: end
#7655
```

0 : Turns the remote line true.

1 : Clears the instrument.

2 : Selects INPUT B, sets the resolution to 10 Hz, turns the service request on, sets the holding state, and sets the offset to -1000 MHz.

3 : Jumps to label "SRQ" upon occurrence of an interrupt.

4 : Label (normally, followed by the main routine).

5 : Enables an interrupt.

6 : Increments I from 1 to 2000.

7 : Displays I.

8 : Executes I = I + 1.

9 : Issues a trigger when I = 2000 is exceeded.

10: Jumps to label WAIT to execute the main routine.

11: Reads the status byte.

12: Prints out the status byte. (Port 6 is for the printer.)

13: Reads data.

14: Prints out the data.

15: Return for an interrupt.

- Data

```
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300000.00 Hz
STATUS =              65.00
Freq. =       521300020.00 Hz
STATUS =              65.00
Freq. =       521300010.00 Hz
```

7.7 D/A OUT and AUX IN/OUT

(See 8.2 for D/A OUT and see 2. and 8.3 for AUX IN/OUT.)

8. THE OTHER OPTIONS

8.1 BCD Parallel Data Output (Option 02)

When the BCD parallel data output option is attached, the data obtained by measurement is output in BCD parallel format, and the measured data can be printed out through the TR6198 Digital Recorder connected to the instrument.
The number of digits of data to be output is nine, counted from the lowest-order display digit.
For the D/A output, the three lowest-order display digits are output as analog data from the rear panel via a D/A converter.

8.1.1 Performance

Data capacity : 9 data digits, 1 function digit, unit, and decimal point

Data output : 1-2-4-8 positive logic

Unit output : 1-2-4-8 positive logic

Output levels : Low: 0 to +0.4 V
High: +2.4 to +5.0 V
Open collector with 10 kΩ pull-up.
Equivalent to 7407.

Output connector
: Amphenol 57-40500 or equivalent

Busy signal input
: Data is output when busy signal is low.

8.1.2 Output Signal Table

Table 8 - 1 Output Signals

Pin No.	Signal name	Pin No.	Signal name
1	GND (0 V)	26	2^0
2	2^0	27	2^1
3	2^1 10^0	28	2^2 10^6
4	2^2	29	2^3
5	2^3	30	2^0
6	2^0	31	2^1
7	2^1	32	2^2 10^7
8	2^2 10^1	33	2^3
9	2^3	34	2^0
10	2^0	35	2^1
11	2^1	36	2^2 10^8
12	2^2 10^2	37	2^3
13	2^3	38	2^0
14	2^0	39	2^1 Function
15	2^1	40	2^0
16	2^2 10^3	41	2^1
17	2^3	42	2^2 Unit
18	2^0	43	2^3
19	2^1	44	2^0
20	2^2 10^4	45	2^1 Decimal point
21	2^3	46	2^2
22	2^0	47	Print command signal output
23	2^1	48	Print end signal input
24	2^2 10^5	49	Busy signal input
25	2^3	50	GND (0 V)

8.1.3 Connection to TR6198 Digital Recorder

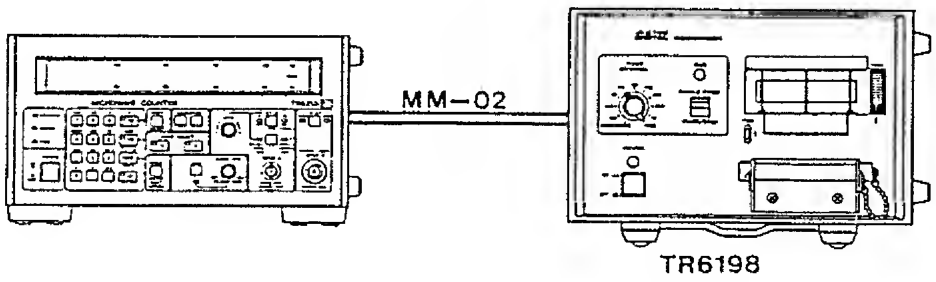


Figure 8 - 1 Connection to TR6198

(1) Connect the instrument and the TR6198 Digital Recorder using connection cable MM-02 as shown in Figure 8-1.
When the print command signal output and the print end signal input are to be used, set the instrument to HOLD (by pressing the HOLD switch), then press the RESET switch; the instrument starts measurement. When the measurement ends, the data is output to the printer. When the data has been printed, the printer outputs a start signal (print end signal) so the instrument can successively output data.
For more information on use of the TR6198 Digital Recorder, refer to its instruction manual.

(2) Timing of data output

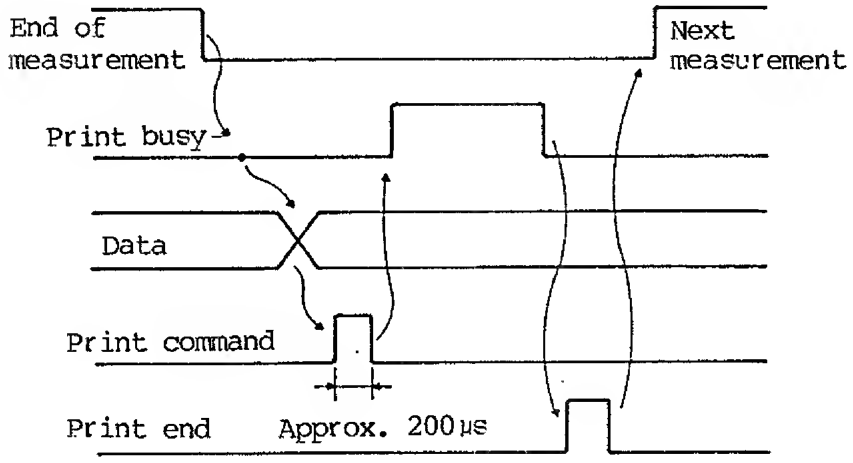
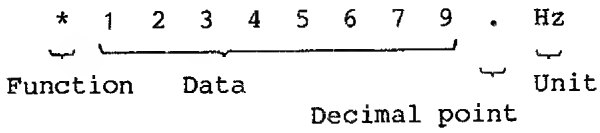


Figure 8 - 2 Timing Diagram of Data Output

NOTE

1. BCD output requires the busy signal to be at low level. When the busy signal is not to be used, connect pin 49 on the instrument side to GND (pin 50).
2. The print command signal output from the instrument is approximately 200 µs positive pulse. It is output when the new data is established following a data change (approximately 20 µs later).
3. The print end signal input to the instrument as a start signal must be a positive pulse having a width of 10 µs or more.

8.1.4 Data Output Format



Function

	2^1	2^0
* (over)	0	1
-	1	0
space	1	1

Data

	2^3	2^2	2^1	2^0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
blank	1	1	1	1

Decimal point

Position	2^2	2^1	2^0
10^0	0	0	0
10^1	0	0	1
10^2	0	1	0
10^3	0	1	1
10^4	1	0	0
10^5	1	0	1
10^6	1	1	0
10^7	1	1	1

Unit

	2^3	2^2	2^1	2^0
GHz	0	0	1	1
MHz	1	0	0	1
kHz	0	0	0	1
Hz	1	1	1	0
µs	0	1	1	0
space	1	1	1	1

When the resolution is changed during measurement of INPUT B consisting of a continuous wave, the output format changes as follows:

Resolution	Data	Unit	Decimal point			Unit			
			2^2	2^1	2^0	2^3	2^2	2^1	2^0
10 MHz	0 0 0 0 0 1 2.3 4	GHz	0	1	0	0	0	1	1
1 MHz	0 0 0 0 1 2 3 4 5.	MHz	0	0	0	1	0	0	1
100 kHz	0 0 0 1 2 3 4 5.6	MHz	0	0	1	1	0	0	1
10 kHz	0 0 1 2 3 4 5.6 7	MHz	0	1	0	1	0	0	1
1 kHz	0 1 2 3 4 5 6 7 8.	kHz	0	0	0	0	0	0	1
100 Hz	1 2 3 4 5 6 7 8.9	kHz	0	0	1	0	0	0	1
10 Hz	2 3 4 5 6 7 8.9 9	kHz	0	1	0	0	0	0	1
1 Hz	3 4 5 6 7 8 9 9 9.	Hz	0	0	0	1	1	1	0
0.1 Hz	4 5 6 7 8 9 9 9.9	Hz	0	0	1	1	1	1	0

8.2 D/A OUT (Also Used With Option 01)

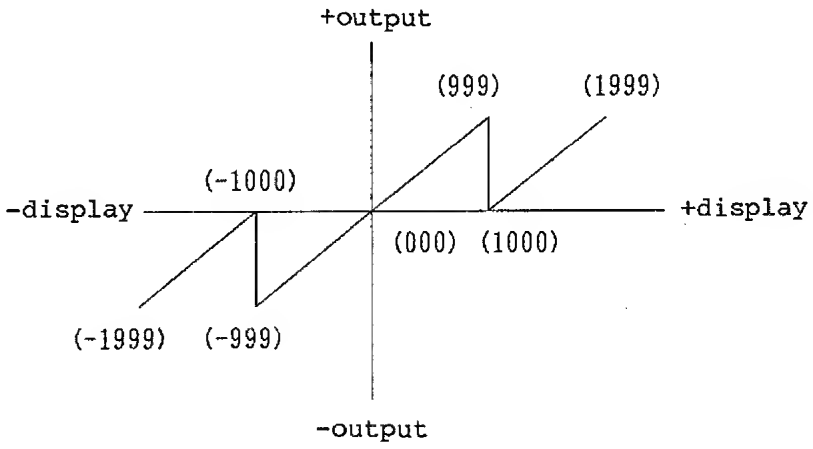
The D/A output is obtained from the AUX IN/OUT connector (output pin 6, GND pin 7). It comes from the three lowest-order display digits (columns) via the D/A converter. It can be either positive or negative, since the displayed data can also be negative when offsetting is made.

8.2.1 Performance

Digits converted: Three lowest-order display digits (columns)
Output voltage : -4.995 to +4.995 V ±20 mV/23°C ± 5°C (Approx. 5 mV/count)
Output impedance: 100 Ω or less for a load of 10 kΩ or more
Output terminal : AUX IN/OUT connector
Output: Pin 6
GND: Pin 7

8.2.2 Correspondence Between Display and Output Voltage

Display	Voltage (V)
+999	+4.995
0	0
-999	-4.995



8.2.3 Shifting Conversion Columns

The three low-order columns displayed after a master reset are set as coversion columns. The conversion columns can be shifted to displayed higher-order columns by pressing SHIFT . This key-in sequence shifts the conversion columns by one position in the higher-order direction after displaying "dAC UP 1" for approximately 1.5 seconds. The conversion columns can be shifted in this way by up to nine positions. (This key-in sequence is ineffective when the three higher-order columns are on display.)

To return to lower-order columns, press [SHIFT] [▷] ; the conversion columns are shifted by one position in the lower-order direction. The conversion columns are set to the three low-order columns on display when dAC UP 0 is displayed.

8.3 AUX IN/OUT (Also Used With Option 01)

When option 01 or 02 is incorporated in the unit, the following signals are also available at the AUX IN/OUT. (See 2. for details.)

Signal name	Option
D/A OUT	option 01/02
INPUT SELECT D0	option 02
INPUT SELECT D1	option 02
COMPARATOR HIGH	option 01/02
COMPARATOR LOW	(option 01/02)

9. SPECIFICATIONS

(1) Electrical Performance

Table 9 - 1 Specifications of R5372/5373/5372P/5373P

Item \ Input	INPUT A		INPUT B
Frequency measurement range	10 mHz to 10 MHz (DC coupling) 10 Hz to 10 MHz (AC coupling)	10 MHz to 550 MHz	500 MHz to 18 GHz (R5372/P) 500 MHz to 27 GHz (R5373/P)
Input impedance	Approx. 1 MΩ/60 pF or less	Approx. 50Ω	Approx. 50Ω
Input sensitivity	25 mVrms	25 mVrms	-20 dBm (500 MHz to 18 GHz) -15 dBm (18 GHz to 27 GHz)
Input attenuation	0 dB, 20 dB selectable 0 dB or 20 dB	ANS (ON, OFF)	AUTO on approx. 20dB
Maximum input level	500 mVrms/ATT. 0 dB 5 Vrms/ATT. 20 dB	500 mVrms/ANS OFF 5 Vrms/ANS ON	0 dBm (ATT: AUTO) +10 dBm (ATT: 20dB)
Damaging input	5 Vrms (1 MHz to 10 MHz) 10 Vrms (400 Hz to 1 MHz) 100 Vrms (DC to 400 Hz)	6 Vrms	+10 dBm (ATT: AUTO) +20dBm (ATT: 20dB)
Input coupling mode	DC/AC	AC	AC
Trigger level	Approx. -1 V to +1 V continuously variable (-10 V to +10 V/ATT. 20 dB)		
Resolution/ gate time	See Figure 9-1	Decade switching from 10 MHz/0.1 µs to 0.1 Hz/ 10 s	Decade switching from 10 MHz/ 0.1 µs to 0.1 Hz/ 10 s

Table 9 - 1 Specifications of R5372/5373/5372P/5373P (Cont'd)

Item \ Input	INPUT A		INPUT B
Measurement accuracy	±(trigger error/number of periods) ±1 count ±time base accuracy (See Figure 9-1 for frequency.)	±1 count ±time base accuracy	±1 count ±time base accuracy; Residual stability:±1/10x frequency[GHz] count rms
Measuring method	Reciprocal scheme	Direct count method	Direct counting made after heterodyne conversion by digital TRAHET system
Input connector	BNC type		N type (R5372/P) SMA type convertible into N type (R5373/P)

(Note) Trigger error: Within ±0.3% of sine wave input at signal-to-noise ratio of 40 dB or more

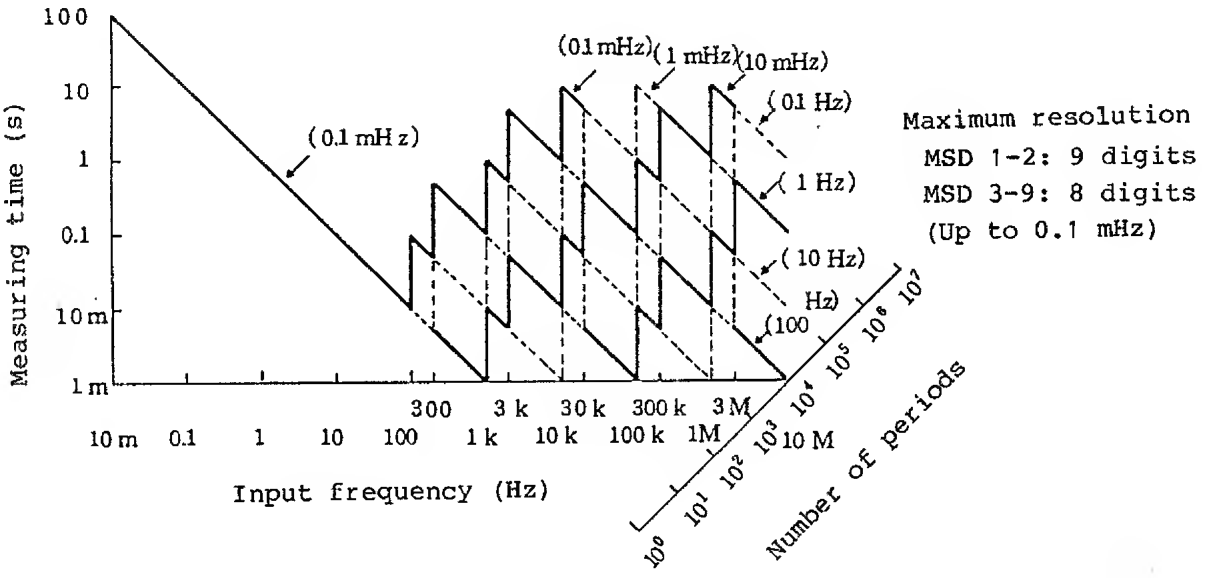


Figure 9 - 1 Measuring Time, Resolution, and Number of Periods Versus Input Frequency

Totalize [INPUT A (up to 10 MHz)]

Counting range : DC to 10 MHz

Counting capacity: 0 to $10^{10}-1$

Pulse width measurement [INPUT A (up to 10 MHz)] (R5372P/5373P only)

Measuring range : 50 ns to 1 s

Resolution for 10-pulse average measurement: 10 ns

Unit of display : µs (fixed decimal point)

Measurement accuracy: (±trigger error/$\sqrt{10}$) ±1 count ±time base accuracy

(Note) Trigger error: $\pm \frac{0.0025}{\text{Signal slope (V/µs)}}$

$\pm \frac{2 \times \text{(peak voltage of noise)}}{\text{Signal slope (V/µs)}}$ [µs]

Measurement mode [INPUT B]

AUTO : Acquisition time: Approx. 300 ms (From resetting to starting of counting)
FM tolerance: Max. 10 MHz p-p

MANUAL : Fixed band determined by frequency key setting.
No acquisition operation is made.
Bandwidth (FM tolerance):
±125 MHz or more(At 1.4 GHz to 18/27 GHz)
±25 MHz or more (At 0.5 GHz to 1.4 GHz)

Pulse-modulated carrier frequency measurement [MANUAL mode]

Measuring range : 100 MHz to 550 MHz [INPUT A]
500 MHz to 18 GHz [INPUT B] (R5372/P)
500 MHz to 27 GHz [INPUT B] (R5373/P)

Pulse width : 0.5 µs (min.) (R5372/5373)
100 ns to 0.1 s (internally synchronized) (R5372P/5373P)
50 ns to 0.1 s (externally synchronized) (R5372P/5373P)

Pulse repetition frequency (f_R): 10 Hz to 5 MHz

Resolution : 1/gate time (Hz) (R5372/5373)

Note : Gate time is the decade step time of 0.1 μs to 10 s which is shorter than the pulse width minus 0.4 μs of pulse modulation wave.

Maximum resolution: See Figure 9-2.

Accuracy : ±1 count ±time base accuracy (R5372/5373)

±1 count ±time base accuracy $\pm \frac{0.04}{GW}$ (Hz rms)
±5 kHz (R5372P/5373P)

Calibration time : $(50\ \mu s + \frac{1}{f_R}) \times (\frac{1}{\text{resolution}} \times \frac{1}{GW}) \times (1 + \frac{1}{\text{resolution}} \times \frac{1}{GW}) + 20$ ms (R5372P/5373P)

(Note) GW: Gate width (In case of internal synchronization, GW is the modulated pulse width minus approximately 50 ns.)

Measuring time : $(50\ \mu s + \frac{1}{f_R}) \times (\frac{1}{\text{resolution}} \times \frac{1}{GW})^2$

Unit of display : Hz, kHz, MHz and GHz (fixed display)

Modulated pulse width measurement (R5372P/5373P only)

Resolution : 10 ns

Accuracy : 30 ns ± time base accuracy

Unit of display : μs fixed

Note: Pulse width at the input sensitivity level is displayed.

Synchronized trigger mode

INT : Gate is opened and closed in synchronism with internal detector output.

EXT START : Gate is opened by external signal, but triggering is possible only when internal detector output is produced.

Input signal level (including sine-wave input)

2 Vp-p or more, 10 Vp-p or less with center voltage of +1.5 V; or 2 Vp-p or more, 10 Vp-p or less for sine-wave input signal with no DC component.

Pulse width

1 µs or more for sine-wave input signal of 100 kHz or less

EXT GATE : Gate is opened and closed by external signals.

Input signal level

TTL active low

Pulse width

50 ns to 0.1 s

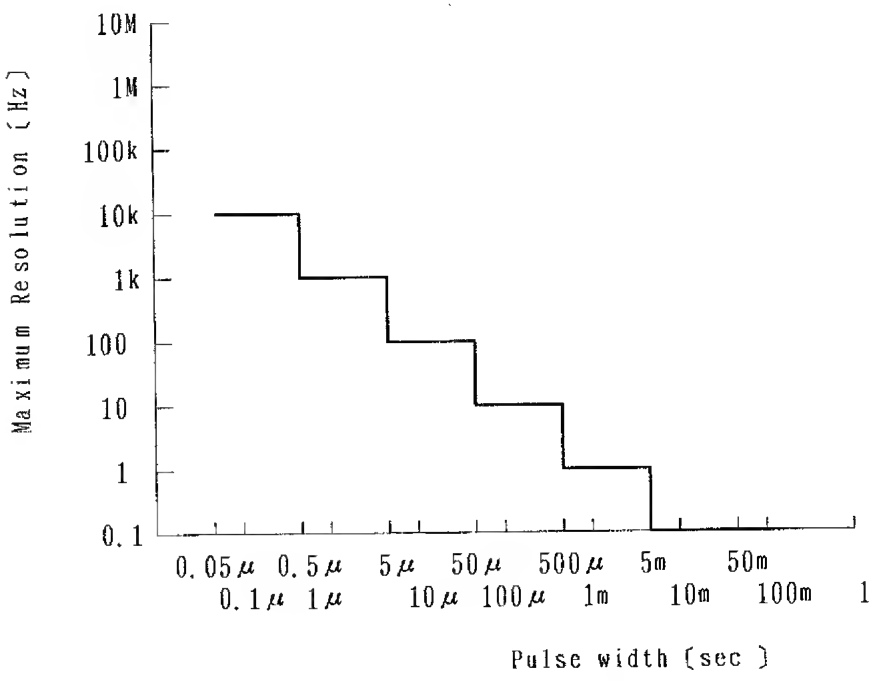


Figure 9 - 2 Relationship Between Pulse Width and Maximum Resolution for the Carrier Frequency Measurement (R5372P/5373P)

LINE : Gate is opened in synchronism with line frequency, but triggering is possible only when internal detector output is produced.

Sample rate : Continuously variable from 50 ms to 5 s and HOLD

Delay time : Continuously variable from 26 µs to 30 ms and OFF (time from INT/EXT/LINE triggering to starting of counting)

Time base

Time base stability: See Table 9-2.

Time base output : 10 MHz, 1 Vp-p or more
Output impedance: Approx. 50 Ω

External time-base frequency
: 1, 2, 2.5, 5, or 10 MHz; 1 to 10 Vp-p
Input impedance:Approx. 500 Ω

Table 9 - 2 Time Base Stability

	Standard specification	Option 21	Option 22	Option 23
Aging rate (long-term stability)	2×10^{-8}/day 8×10^{-8}/month (1×10^{-7}/year) (After operating 24 hours)	5×10^{-9}/day 5×10^{-8}/month (8×10^{-8}/year) (After operating 24 hours)	2×10^{-9}/day 2×10^{-8}/month (5×10^{-8}/year) (After operating 48 hours)	5×10^{-10}/day 1×10^{-8}/month (2×10^{-8}/year) (After operating 48 hours)
Temperature coefficient (25°C±25°C)	$\pm5\times10^{-8}$	$\pm5\times10^{-8}$	$\pm1\times10^{-8}$	$\pm5\times10^{-9}$
Warmup *1 (Specified time)	$\pm5\times10^{-8}$ (30 minutes)	$\pm2\times10^{-8}$ (1 hour)	$\pm1\times10^{-8}$ (1 hour) ($\pm4\times10^{-9}$)*3	$\pm1\times10^{-8}$ (1 hour) ($\pm1\times10^{-9}$)*3
Reproducibility *2 (Specified time)	$\pm5\times10^{-8}$ (30 minutes)	$\pm3\times10^{-8}$ (1 hour)	$\pm2\times10^{-8}$ (1 hour) ($\pm1\times10^{-8}$)*4	$\pm1.5\times10^{-8}$ (1 hour) ($\pm5\times10^{-9}$)*4

*1 Difference between the frequency measured when the specified time (30 minutes or one hour) has lapsed after powering on and that measured when 24 hours have lapsed after that specified time.

Table 9 - 2 Time Base Stability (Cont'd)

*2 Difference between the frequency measured when the specified time has lapsed after powering on within 24 hours after last powering the instrument off and that measured immediately before last powering the instrument off.

*3 Difference between the frequency measured when 24 hours have lapsed after powering on within 24 hours after last powering off and that measured when 48 hours have lapsed.

*4 Difference between the frequency measured immediately before powering off and that measured when 24 hours have lapsed after subsequently powering the instrument on.

STD IN/OUT connector: BNC type

Backup power supply for memory: The memory is backed up as long as AC power is supplied. If the power supply cable is unplugged with the internal Ni-Cd battery charged, the memory is backed up for up to about 2 weeks. Charging the Ni-Cd battery takes 2 to 3 days.

AUX INPUT/OUTPUT

Input/output signals: Gate signal output, detector output, external reset signal input, measurement end signal output (TTL level)

Computation capabilities: Maximum value holding, minimum value holding,deviation [(maximum deviation) - (minimum deviation)], standard deviation, averaging, digital comparison GO/NO GO decision, display of marker frequency of TR4110 series Spectrum Analyzer, ppm, addition, subtraction, multiplication, division

(2) General specifications

Display	: Green 7-segment LEDs (approx. 11 mm high) storage display
Operating temperature range	: 0 to +40°C
Operating humidity	: 85% rh or less
Storage temperature range	: -20 to +70°C
Power requirements	: 100 VAC (120 V, 220 V) ±10% or 240 VAC $^{+4}_{-10}$%, 50/60 Hz
Power consumption	: 90 VA or less (R5372/5373) 120 VA or less (R5372P/5373P)
Dimensions	: (W) 255 x (H) 132 x (D) 420 mm (approx.)
Weight	: 10 kg or less

(3) Options

① GPIB interface (Option 01. This interface is equipped as standard feature)
Complies with IEEE standard 488-1978.
The output of display data and all key settings on the front panel can be externally controlled.

② BCD parallel data output (Option 02 only. Note that either option 01 or 02 can be equipped.)
TTL positive logic
The nine low-order display digits are output in BCD parallel format for connection to the TR6198 Digital Recorder.

③ Option 01/02 common specifications

AUX INPUT/OUTPUT:

Gate signal output, detector output, external reset signal input, and measurement end signal input are enabled. TTL input/outut level. 14-pin connector (Amphend 57-40140 or equivalents)

D/A converted analog output: (Output from AUX INPUT/OUTPUT connector)

Number of digits converted: Three least significant digits in the display

Output voltage: -4.995 to +4.995 V ±20mV/23°C ± 5°C

Output impedance: 100 Ω or less for a load of 10 kΩ or more

Digital comparator output: TTL active low, open collector (Output from AUX INPUT/OUTPUT connector)

APPENDIX

This section explains the principles of operation of the R5372/5373 and R5372P/5373P microwave frequency counters, with the description of the operation of each functional block.
Detailed schematic diagrams are located at the rear of this manual. For terminology, refer to the glossary.

A.1 Basic Principles of Operation

The R5372/5373/R5372P/5373P has two independent signal input connectors: INPUT A connector covering a frequency range from 10 mHz to 550 MHz, and INPUT B connector covering a frequency range from 500 MHz to 18 GHz for the R5372/5372P, or INPUT B connector covering a frequency range from 500 MHz to 27 GHz for the R5373/5373P.
The R5372/5373 basic block diagram is shown in Figure A-1.
The R5372P/5373P basic block diagram is shown in Figure A-2.

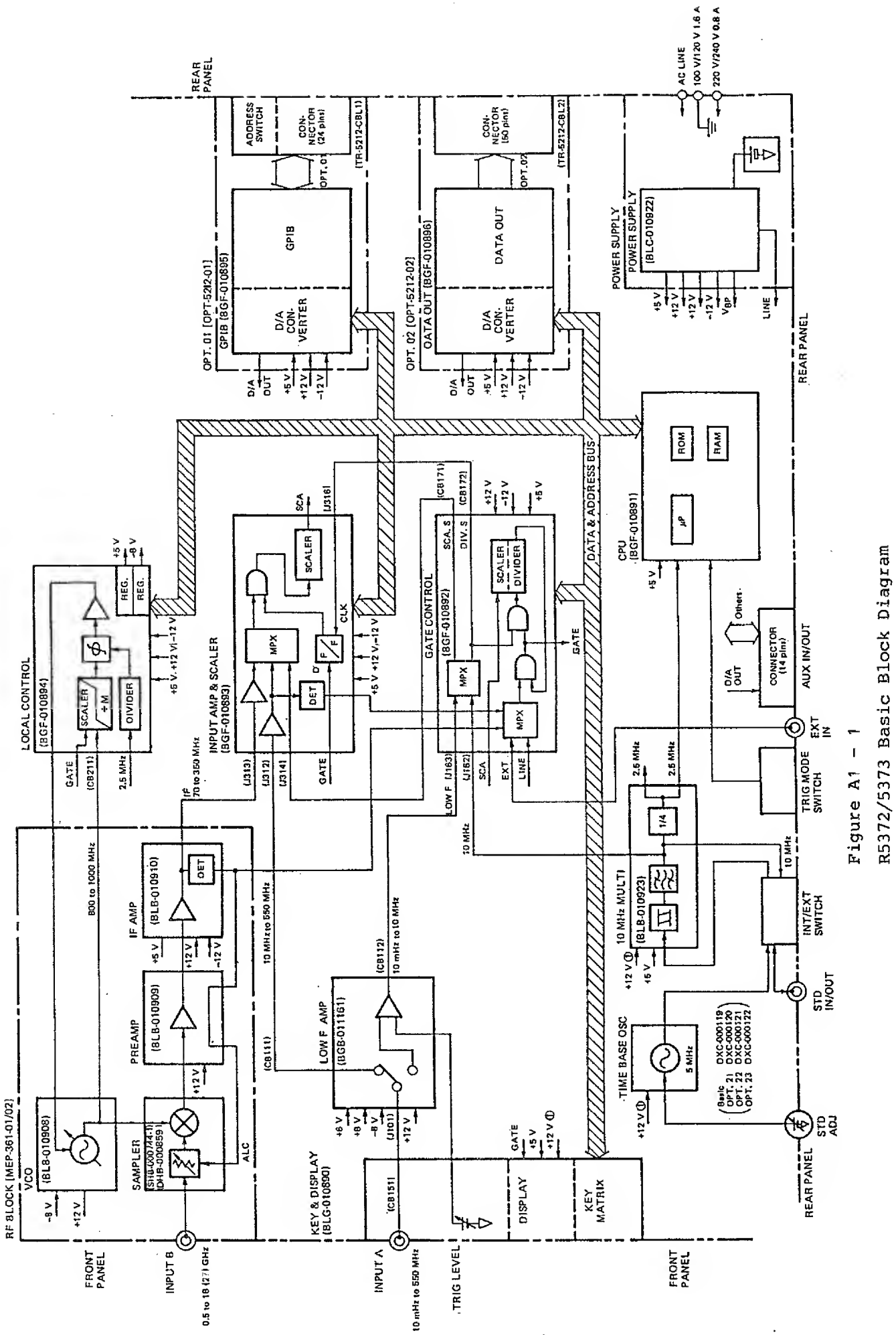


Figure A1 - 1

R5372/5373 Basic Block Diagram

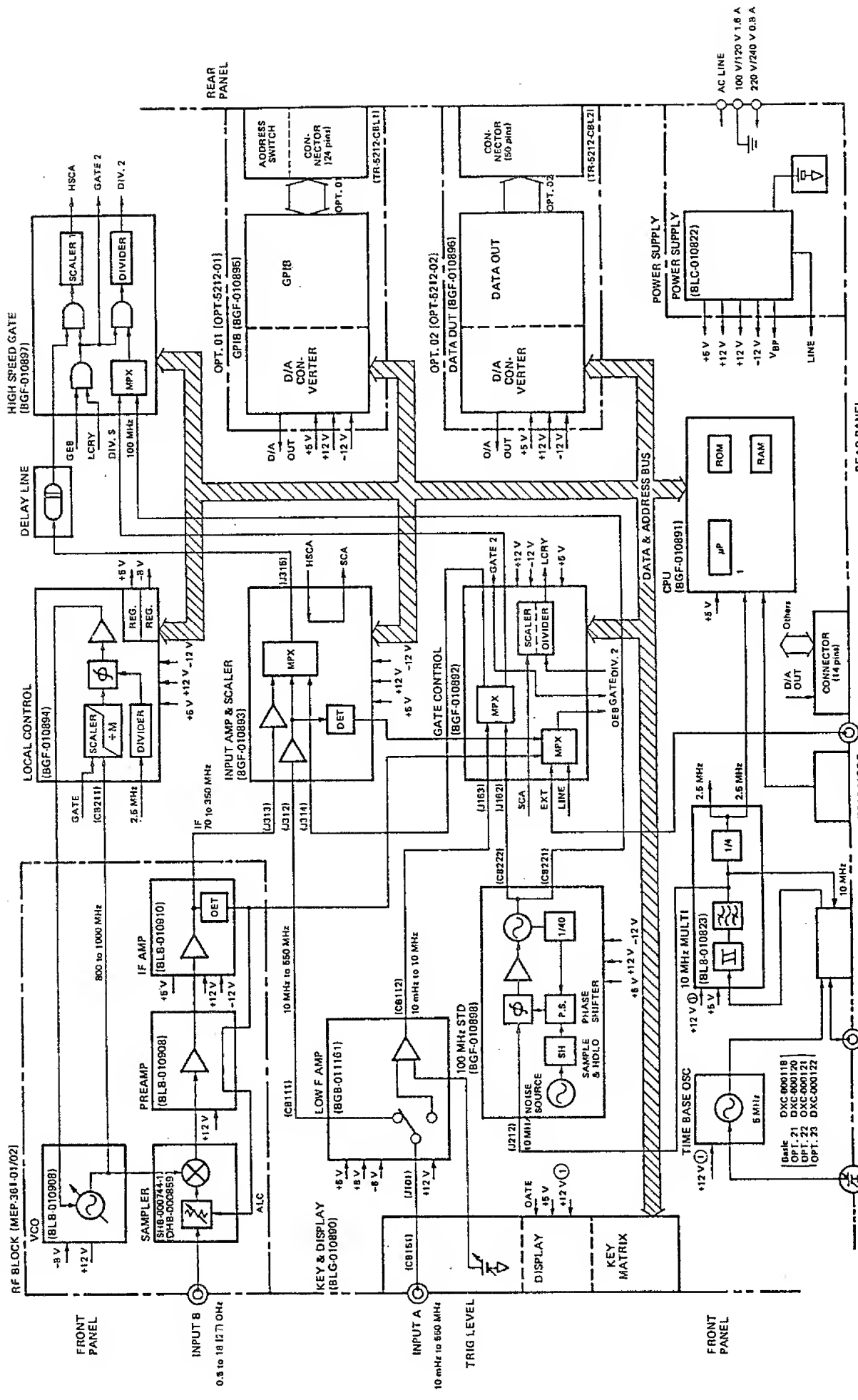


Figure A1 - 2

R5372P/5373P Basic Block Diagram

A.1 Basic Principles of Operation

The input-A measurement scheme varies with the frequency bands of 10 mHz to 10 MHz and 10-550 MHz.
The input-A measurement in the 10 mHz to 10 MHz band utilizes the reciprocal system. An unknown signal is fed to the LOW F AMP (BGB-011161) via the INPUT A connector on the front panel. The input signal amplified and waveform-shaped by the LOW F AMP is sent to the GATE CONTROL (BGF-010892) and input to the divide-by-10^n divider to generate a gate signal with a number of periods of 10^n depending on resolution. A 10 MHz reference signal* generated by the 10 MHz MULTI (BLB-010923) is routed to the INPUT AMP & SCALER (BGF-010893 or BGF-012541). The scaler counts the number of reference signals through the gate time generated by the above input signal. Then, the counted data are computed by the µCPU and displayed.
The R5372P/5373P contains first- and second-stage scalers and first-stage divider in the HIGH-SPEED GATE (BGF-010897).

* This refence signal is input to the 100 MHz STD (BGF-010898) and output as a 100 MHz standard output in the R5372P/5373P.

The input-A measurement in the 10-550 MHz band utilizes the direct counting system. An input signal applied to the INPUT A connector is fed to the INPUT AMP & SCALER (BGF-010983 or BGF-012541) via the LOW F AMP (BGF-011161). The signal, amplified and waveform-shaped by the INPUT AMP & SCALER, is sent to the scaler. The scaler counts the number of the input signals through the gate time derived from dividing the reference signal. Then, the counted data is displayed.
Input B consists of microwaves over the 500 MHz to 18 GHz band for the R5372/5372P and 500 MHz to 27 GHz band for the R5373/5373P. The input signal is converted to an intermediate frequency by the digital TRAHET technology, then directly counted.

The input signal applied to the INPUT B connector is fed to the SAMPLER (SHB-000744-1 for the R5372/5372P and DHB-000851 for the R5373/5373P). The input signal is mixed with a local frequency signal generated by the voltage-controlled oscillator (VCO) (BLB-010908 or BLB-012208). The SAMPLER produces an intermediate frequency signal equal to the difference between the input signal and an integral multiple of the local frequency signal. The intermediate frequency is amplified by the PREAMP (BLB-010909) and IF AMP (BLB-010910 or BLB-012207), waveform-shaped by the INPUT AMP & SCALER, to be directly counted by the scaler.
The relationships between input frequency to be measured Fx, local frequency F , and IF signal Fif are expressed as follows:

$$|Fx - F| = Fif$$

From the above, the harmonic number N in the mixer is obtained from the following equation:

$$N = Fif / F$$

As known from this equation, the harmonic number N in the mixer is determined by the ratio of the intermediate frequency variation to the local frequency variation. The local frequency is in phase with those of the time-base frequency. Therefore, input frequency Fx can be measured to an accuracy of the time-base frequency using the following equation operated by the μCPU:

$$Fx = NF \pm Fif$$

If the user manually sets the approximate value of a frequency to be measured using the key switches on the front panel, a local frequency can be set so that an intermediate frequency is generated in the frequency set on the IF AMP when a frequency to be measured is input. In this state, the counter is ready to measure the manually set frequency, so it starts counting of the input frequency using the intermediate frequency detection signal as a synchronizing signal. This method enables this counter to measure a carrier frequency of pulse-modulated waves.

The R5372P/5373P, developed to measure pulse-modulated waves has gate synchronizing signals such as internal detection, line frequency synchronizing, and external synchronizing signals. These signals are selected by the gate multiplexer. To synchronize a narrow-width pulse with a gate signal, the R5372P/5373P provides a phase-locked loop to generate 100 MHz clocks. The R5372P/5373P also achieves randomness between the signal to be measured and the gate signal by changing the phase for each gate at random with the noise voltage applied to the phase-locked loop.
When each measurement is random, the averaging resolution is obtained from the following formula:

$$\text{Resolution} = \frac{\text{Single measurement resolution}}{\text{Number of measurements}}$$

If the resolution of the R5372P/5373P is set to a value less than a frequency as the reciprocal of a burst pulse width, the measurement can be automatically performed in the shortest time according to the set resolution by obtaining the required number of measurements from the scaler-2 measurement count by the µCPU. This method enables the R5372P/5373P to perform a high-resolution measurement by a true averaging. The µCPU controls each section according to the measurement routine program written in the ROM and operates data from the circuit for counting, before being displayed. The data output and GPIB are also connected to the bus of the µCPU, and their data is sent to an external unit in the specified format.

A.2 Glossary

Acquisition Time

Acquisition time means the time from counter resetting to the start of counter operation. The acquisition time of ordinary counters is virtually zero, whereas microwave-band counters require a certain acquisition time. For the TR5200 series counters of ADVANTEST, the acquisition time refers to the time required until the internal oscillator is phase locked to the input signal.

ALC (Automatic Level Control)

A function to detect and correct the DC fluctuation in the circuit caused by temperature drift from the input terminal to the output of the wide-band amplifier.

ANS (Automatic Noise Suppressor)

ADVANTEST's patented technique.
A circuit that automatically suppresses the noise riding on the signal to be measured.

Automatic Filter

Cutoff frequency is automatically selected according to the incoming frequency to eliminate random noise or noise added on the input signal, thereby preventing errors associated with noise. Automatic filter makes up for the disadvantages that the ANS capability contributes little to the suppression of random noise, impulse noise or noise larger than the signal of interest while it serves well for suppression of the superimposed noise.

Automatic Trigger Setting

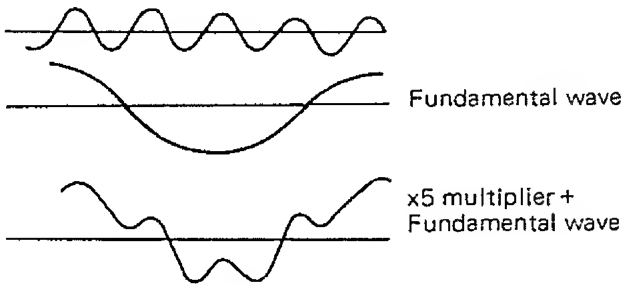
Trigger level setting is quite difficult and bothersome when the signal to be measured is small. This setting operation is simplified by the automatic trigger setting. Trigger level is automatically set at the 50% level between the maximum and minimum peaks of the input signal. This capability facilitates the trigger level setting on the pulsed signal with the offset voltage or of different duty cycles, and minimizes false counting.

Averaging

Two circuit methods are usually used for averaging in electronic counters. One is used in the time interval measurement to count each time interval with the counting circuit and accummulate. Let N be the number of measurements, and ±1 count/$\sqrt{N}$ is part of measurement precision. The other method is the one used in period measurement to form a gate with the period signal to be measured to measure the gate time with the internal time base. One factor of measurement precision is ±1 count/N. Both averaging methods are used to enhance measurement precision of electronic counters; however, the inherent error factors inside the instrument (propagation delay time difference, Schmitt trigger circuit hysteresis band) cannot be improved. Therefore, the upper limit of the number of effective measurements accrues. In using the averaging function, the ±1 count error must be guaranteed to occur at random. A counter usually sends the signal to be measured to the counter gate circuit completely asynchronous with the internal time base and the error can be regarded to occur at random.

Bandwidth

For electronic counters, noise is a cause of counting errors and must be considered in relation to sensitivity.
The bandwidth switch is used to remove the high-frequency component (see figure below) with a low-pass filter of 10 MHz, 5 MHz, etc. This function is useful in measurement of oscillation and multiplied waves in a multiplier circuit.



COM-SEP Switch

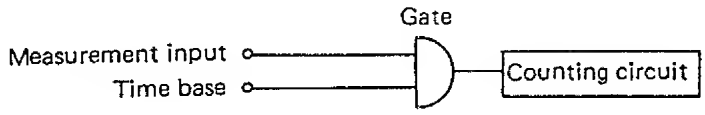
A switch to be selected to suit the signal to be measured in time interval measurement. When this switch is set to COM., the start and stop signals are internally connected enabling a time interval measurement on a single signal. SEP. switch separates the start and stop signals, requiring the two signals, of start and stop, to be measured. (COM: Common; SEP: Separate)

Counting Resolution

The least significant digit on the readout. Counting resolution differs with gate time. At a gate time of 1 second, the resolution is 1 Hz with a typical counter.

Direct Counting

The direct counting is the most fundamental method to measure the frequency. (See the figure below.) This scheme is widely used from the audio frequency band to the UHF band. In the direct counting method, the upper limit of frequency measurement is determined by the gate time and the frequency resolution. Enhancement of the performance of the semiconductor devices and advanced circuit board technology have realized a counter of 1 GHz utilizing the direct counting techniques.



Expanding Reciprocal Method

The method used by electronic counters to measure a period, execute inverse calculation (1/period), and display the frequency is called the reciprocal method.
The main feature of this method is that, in period measurement, it enables frequency measurement of high-resolution and high-precision up to the order of the internal time base. For example, let the time base be 100×10^{-9}s, then 7-digit display is always possible when a frequency (10 MHz or less) is measured at a gate time of 1 second. To obtain a 10-digit display at a gate time of 1 second with this method, the internal time base must be 100×10^{-12}s (equivalent to 10 GHz). To realize a 10 GHz time base, the time expander method is used together with the reciprocal method, thus enabling a high-resolution high-precision frequency measurement. This method is called the expanding reciprocal method. (* See Time Expander Method.)

Gate Time

The time during which a counter measures the input signal. During this time, the GATE lamp usually goes on to notify the user that the input signal is being measured.

Input Coupling

There are two input coupling methods: the AC coupling that cuts out the DC input signal and passes the AC component alone, and the DC coupling to measure low frequencies.

Masking

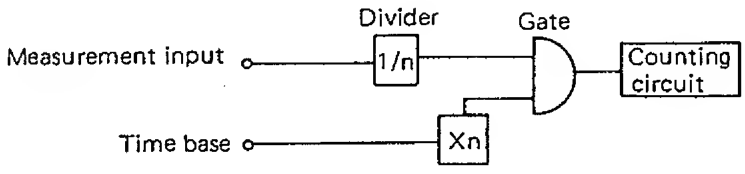
With a masking function, regardless of the magnitude of noise, desired signal alone is made available by inhibiting for a required period of time the wave-shaped output. By adjusting the masking time, this function makes possible the measurements of the signal in noise including a chattering noise or the modulated wave signal.

Oven Lamp

A lamp that indicates activation of the crystal-oven heater and the internal reference circuit when the counter is connected to the AC power source regardless of the POWER switch operation.

Prescaler

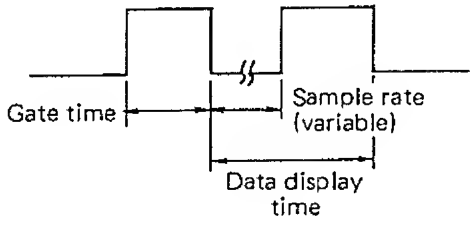
The prescaler divides the input frequencies by a factor of n with a divider for counting. (See the figure below.) In this case, the counting result is 1/n of the actual frequency; therefore, the time base is multiplied by n to display the frequency measurement. This requires a gate time equal to n times that required for the direct counting method; with the same gate time, the resolution is 1/n. In the prescaler, the upper limit of the measured frequency is determined by the frequency resolution of the divider. The gate is operated by the 1/n frequency, enabling measurement of higher frequencies than by the direct counting method. At present, a 1.5 GHz prescaling counter is available.



Sample Rate

A function to continuously vary the display time of the measurement result. As a matter of fact, the gate time is determined by the resolution of the counter. The display time can be changed by varying the time from the end

of a measurement to the start of the next measurement by using the sample rate function. Thus, the data display time can be altered by varying the sample rate.



Data display time = Gate time + Sample rate time

Time Base, Internal/External

Frequency counters are used for measuring time or counting the number of pulses during a certain period of time. To obtain an accurate measurement result, a time base generator is needed to generate an accurate time. Most counters incorporate a crystal oscillator as the internal time base generator. The accuracy of this generator determines the accuracy of the frequency counter.
If a generator with greater accuracy than the built-in generator is externally available, greater measurement accuracy of the counter is obtained by replacing the internal generator with the output of the external generator. The output of this external generator is called the external time base.

Time Expander Method

The ± count error caused by the relationship between the electronic counter internal time base (for example, 10 MHz) and the time interval to be measured or 1-cycle time is used as a significant time value. Let the difference time occurring at the leading edge of the time to be measured be ΔT_1 and the difference time occurring at the trailing edge be ΔT_2, then the time to be measured $T_X = N \cdot T_0 \pm \Delta T_1 - \Delta T_2$ (where T_0 = internal time base, N = positive integer). $\Delta T_1 - \Delta T_2$ can be read at a better precision by a factor of 100 or 1,000 by converting the difference times to analog voltages by a high-speed time-voltage converter, then A/C converted with a high speed and high precision. Assuming the time base to be 100×10^{-9}s, T_X is equal to resolution 1×10^{-9}s or 100×10^{-12}s. This method of expanding the difference time is the time expander method.

Time Interval Average, Period Average

Counters can measure period and time interval. With a single measurement, the display is unstable and difficult to read or the measurement value is not

reliable if the input signal is interfered with noise or unstable. To solve this problem, counters have a feature to average 10 or 100 measurement values to reduce the influence of noise and input variation. This function is called the time interval average and period average to distinguish from a single measurement. Time required for average measurement is as many times longer as the number of averages taken.

Trahet Method

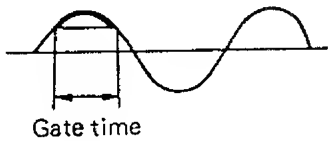
ADVANTEST's patented technique (US PAT. No. 3932814).
This method uses a YIG tuning oscillator with excellent linearity, taking advantage of the transfer oscillator and the heterodyne conversion techniques.

Trigger Level

When a signal is input to a frequency counter, the input signal must cross a certain level (also called the threshold value) for the counter to sense it as a signal and measure it. This level is called the trigger level. The level can usually be varied with a potentiometer, etc.

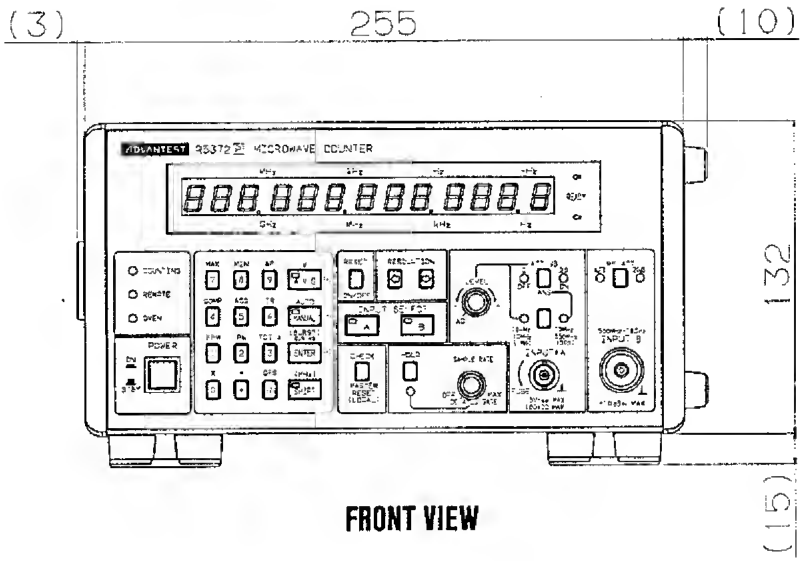
Trigger Monitor Output

A signal output from the trigger monitor circuit as an auxiliary means when a counter is measuring time interval. An osciloscope (with Z-axis modulation terminal) shows intensity modulation on the waveform for each gate time. The measured portion on the trace is intensified as shown below.



Trigger Slope

For a frequency counter to sense an input signal, the input signal should meet the two requirements. One is that the signal must cross the trigger level, and the other is that the slope of the input signal must match the preset trigger slope. With the trigger slope set to plus (+), the counter senses the input signal when the input signal crosses the trigger level from minus (–) to plus (+).

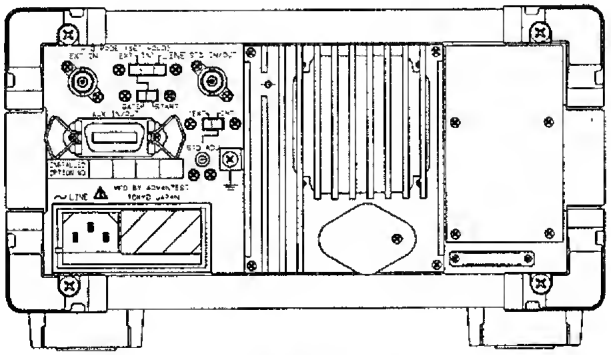


FRONT VIEW

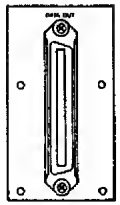


SIDE VIEW

Unit : mm



REAR VIEW



DATA OUT PANEL

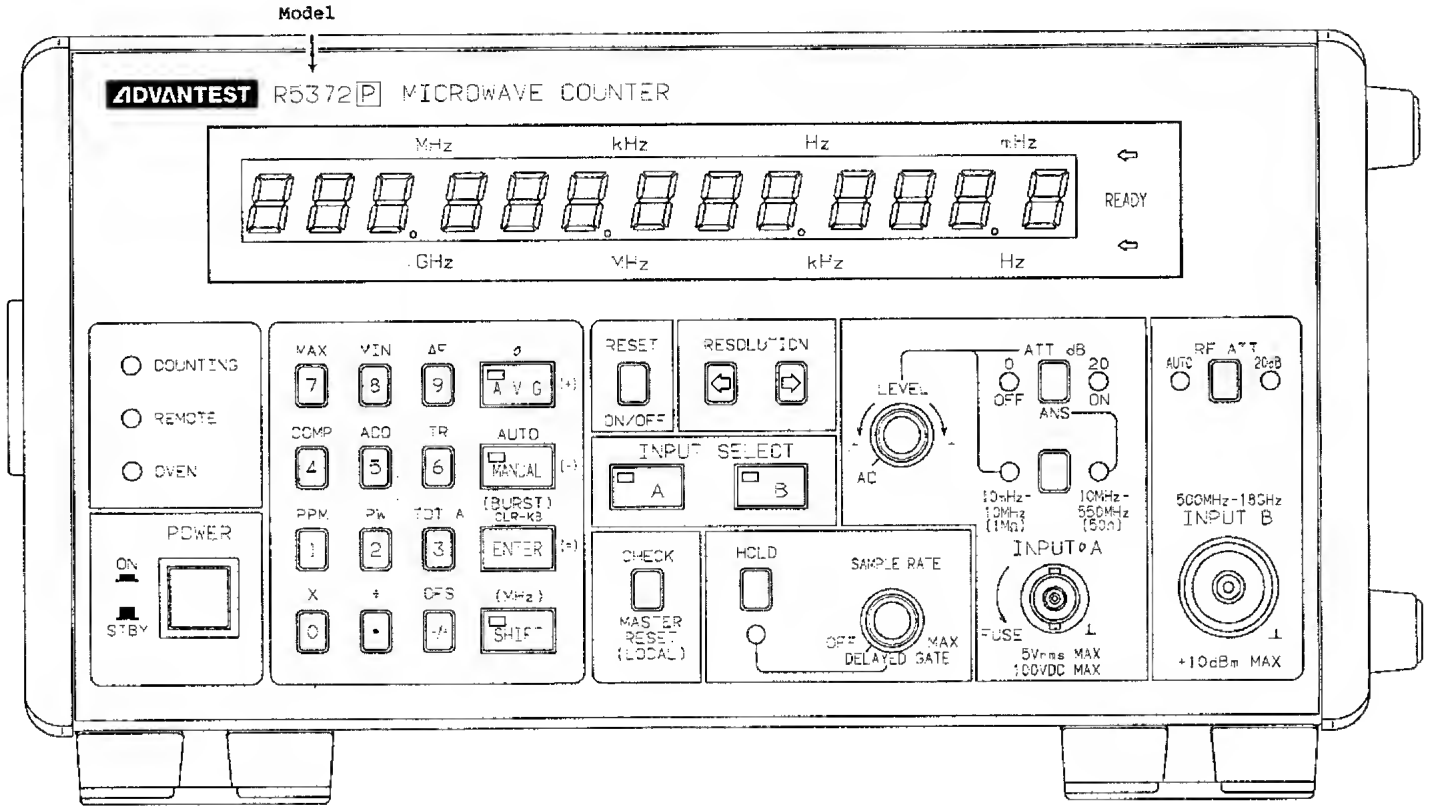


GPIB PANEL

R5372/73/PEXT1-910-B

R5372/73/P

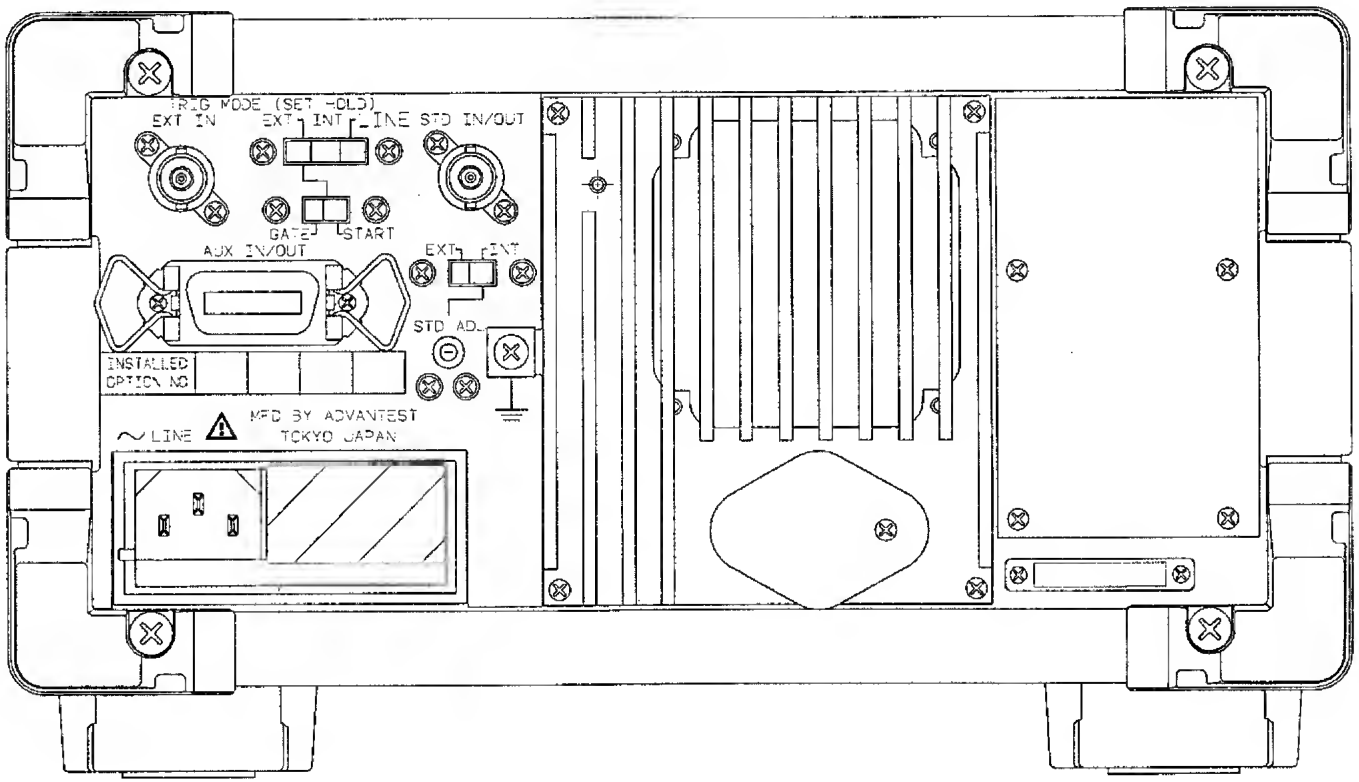
EXTERNAL VIEW



R5372/73/PEXT2-910-B

R5372/73/P

FRONT VIEW



R5372/73/P

REAR VIEW

R5372/73/PEXT3-910-B

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