ADVANTEST

ADVANTEST CORPORATION

TR5830

Universal Counter

Operation Manual

MANUAL NUMBER FOE-8324259A01

First printing May 20, 1991
Printed in Japan

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. GENERAL

1.1 Outline

The **TR5830** Series Universal Counter alone can measure various parameters such as frequency, period, time interval, average time interval, phase shift, average phase shift, time ratio, average time ratio, and frequency ratio. In addition, the counter supports a large number of measuring functions. It has a statistic calculation function as well as addition and subtraction functions that can edit and display the results through easy key input. Also, the counter has a standard GPIB data output/remote control for system component application, and an optional C-input unit (option 21) for measuring range expansion up to 1,000 MHz.

The TR5830 uses both a time expander system that supports up to 0.7-nanosecond, single-pulse time measurement and display resolution and an expanding reciprocal system that supports 10-digit frequency measurement per second for each gate. The counter can be used for a wide range of applications from sub-nanosecond measurement to high-speed, high-resolution measurement. It covers very high-speed logic circuit measurement, jitter measurement in PCM communications, and long and short-time crystal oscillator stability tests.

1.2 Accessories

The TR5830 has the following standard accessories. Check their quantity and rating.

(1) Signal input cable:
MI-02 (UG-58/U BNC-BNC connectors) 3 cables

(2) 0.25A fuse:
EAWK 0.25A (OLVIS) 2 fuses

(3) 3.15A fuse:
EAWK 3.15A (OLVIS) 2 fuses

(4) Operation manual: 1 set

Note: The 0.125A and 2.0A fuses are supplied with the 200VAC model.

1.3 Options

An optional C-input unit is available for measuring range expansion up to 1,000 MHz. See Chapter 4 for details.

C-input unit (option No. 21)

Function:	Measures the frequency, period and frequency ratio.
Measuring range:	80 MHz to 1,000 MHz (1 nsec to 12.5 nsec) in 1/100 pre-scale
Maximum input sensitivity:	10 mVrms

1.4 Peripherals that can be attached to the TR5830

TR3110 portable frequency secondary standard

Can be used for calibrating the internal reference time of the **TR5830.** It can also be used as the reference frequency source of the counter.

1.5 Electrical Characteristics and Specifications

Standard time stability has been defined after a standard preheating time with a power supply of 100 VAC = ±10% or less, 50/60 Hz, 0 to +40°C ambient temperature, and 85% or less humidity.

TR5830 series specifications

Frequency/period measurement (at inputs A, B and C (optional))

Measuring range:

		INPUT A		INPUT B (1/10 pre-scale)	
		Frequency	Period	Frequency	Period
During DC coupling		0.001 Hz to 10 MHz	100 ns to 1000 s (999.999999999)	0.01 Hz to 100 MHz	10 ns to 100 s (99.9999999999)
During AC coupling	50 Ω	2 MHz to 10 MHz	100 ns to 500 ns	2 MHz to 100 MHz	10 ns to 500 ns
	1 MΩ	100 Hz to 10 MHz	100 ns to 10 ms	100 Hz to 100 MHz	10 ns to 10 ms

Measuring time:

Input A: Input frequencies of 10^0, 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7 and 10^8 can be set. Also, one of the following can be set.

1 sec or less (1 Hz or higher input frequency for 0.1 to 1 sec)
One input time period if the frequency is less than 1 Hz

0.1 sec or less (10 Hz or higher input frequency for 0.01 to 0.1 sec)
One input time period if the frequency is less than 10 Hz

0.01 sec or less (100 Hz or higher input frequency for 0.001 to 0.01 sec)
One input time period if the frequency is less than 100 Hz

Input B: Input frequencies of 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8 and 10^9 can be set. Also, one of the following can be set.

1 sec or less (10 Hz or higher input frequency for 0.1 to 1 sec)
10 input time periods if the frequency is less than 10 Hz

0.1 sec or less (100 Hz or higher input frequency for 0.01 to 0.1 sec)
10 input time periods if the frequency is less than 100 Hz

0.01 sec or less (1 kHz or higher input frequency for 0.001 to 0.01 sec)
10 input time periods if the frequency is less than 1 kHz

Input sensitivity: 140 mVp-p (50 mVrms) or less for both input A and input B

Display resolution:

Frequency measurement: 10 digits, 1-second measuring time conversion

Period measurement : 10 digits, 1-second measuring time conversion

Display unit:

Frequency measurement : mHz, Hz, kHz, MHz and GHz

Period measurement : sec, msec, μsec, nsec and psec

Measuring accuracy: See Section 2.16.1, Item (d).

Time period measurement (at INPUT A and INPUT B)

Measuring range:

Synchronous (SYN) mode: -1000 to +1000 sec
(-999.999999999 to +999.999999999 sec)

Asynchronous (ASY) mode: 10 nsec to 1000 sec
(+10 nsec to +999.999999999 sec)

Measuring signal repeat rate: Up to 100 MHz

Average time period measurement:
Sample counts of 10^0, 10^1, 10^2, 10^3 and 10^4 can be set. However, the single pulse time period measurement can be set for 10^0.

Display resolution: 0.7 nsec

Display unit: sec, msec, μsec and nsec

Measuring mode: Common (COM) or separate (SEP)
Use the INPUT A terminal in the COM mode, and both the INPUT A and INPUT B terminals in the SEP mode.

Measuring accuracy: See Section 2.16.2, Item (b).

Phase measurement (at INPUT A and INPUT B)

Measuring range: -180 to +180 degrees
(The phase of the separate time period divided by a single period at input A is displayed.)

Measuring frequency range: Up to 100 MHz

Average measurement: Sample times of 10^0, 10^1, 10^2, 10^3 and 10^4 can be set.

Display resolution:

$$\frac{0.7 \text{ nsec}}{1 \text{ input time period}} \times 360 \text{ degrees or more}$$

Display unit: DEG (degrees)

Measuring accuracy:

$$\pm 360° \text{DEG.} \times \frac{\text{Time period measuring error (sec)}}{\text{Period (sec)}}$$

Time rate measurement (at INPUT A and INPUT B)

Measuring range: 1.0×10^{-10} to 1.0×10^{0}

COM mode : The common time period divided by a single period of input A is displayed.

SEP mode : The separate time period divided by a single period of input A is displayed.

Measuring signal repeat rate: Up to 100 MHz

Average measurement: Sample times of 10^0, 10^1, 10^2, 10^3 and 10^4 can be set.

Display resolution: Up to 9 significant digits in (2-digit) exponential display

Measuring accuracy:

$$\pm \frac{\text{Time period measuring error (sec)}}{\text{Period (sec)}}$$

Time rate measurement (at INPUT A, INPUT B, or optional INPUT C)

Measuring mode and range:

B/A mode: INPUT B frequency divided by INPUT C frequency (10^{-9} to 10^{11})
C/A mode: INPUT C frequency divided by INPUT A frequency (8 to 10^{12})
C/B mode: INPUT C frequency divided by INPUT B frequency (0.8 to 10^{11})

Display resolution: Up to 9 significant digits in exponential display

Measuring accuracy: See Section 2.16.4, Item (b).

Input specifications (at INPUT A and INPUT B)

Minimum input pulse width : 5 nsec

Input sensitivity: 140 mVp-p (50 mVrms) or less at INPUT A and INPUT B

Input voltage:

		"×1" sensitivity	"×10" sensitivity
Input voltage range		±1.0V	±10V
Max.input signal amplitude voltage		1.4 Vp-p (Approx. 500 mVrms)	14.0 Vp-p (Approx. 5 Vrms)
Breakdown input voltage	50Ω	5 Vrms	5 Vrms
	1 MΩ	100 Vrms/ DC to 100 kHz 5 Vrms/ 100 kHz to 100 MHz	100 Vrms/ DC to 100 kHz 25 Vrms/ 100 kHz to 100 MHz

Input protection: Built-in fuse for overcurrent protection

Input mode: Switch selectable between AC and DC coupling

Input impedance: Switch selectable between 50 ohms and approx. 1 megaohms (40 pF)

Trigger slope:	Switch selectable between positive and negative slopes
Trigger level:	Variable within -1.0 to +1.0 V (continuous); preset to 0 VDC.
Input filter:	100 kHz low-pass filter for input A only; the filter can be turned on or off (at approx. -3 dB point).
COM/SEP mode input:	INPUT A is used for common input in the COM mode; INPUT A and INPUT B are separately in the SEP mode. (The COM input conditions such as input mode, input impedance and sensitivity can be set for INPUT A. The trigger slope and trigger level can be set for INPUT A and INPUT B separately.)
Input terminals:	BNC connectors are used for INPUT A and INPUT B.

Statistics operation functions

The following four types of statistics processing can be used for frequency, period and time interval measurement.

Statistics operation and time:

Average ($\bar{X}$);	Arithmetic average value; up to 20 msec
Minimum value (MIN) ;	The minimum value of collected data; up to 20 msec
Maximum value (MAX);	The maximum value of collected data; up to 20 msec
Standard deviation (σ);	The standard sample deviation of the collected data; up to 65 msec

Sample count (SAMPLE NUMBER):	The number of sample data sets; 10^1, 10^2, 10^3 or 10^4 can be set. (If 10^0 is set, this function is turned off automatically.)
Display unit:	pHz, nHz, μHz, mHz, Hz, kHz, MHz, GHz, psec, nsec, μsec, msec, sec, ksec, and Msec

Addition and subtraction functions

When value is set from the numeric keypad on the front panel or from the offset key switch, the addition or subtraction result can be displayed using the frequency, period or time interval function. However, if the value is set from the numeric keypad, the decimal point and unit of the previous measuring results are used.

Operation mode

① Addition or subtraction of key input value and measured data
(Measured data) ± (Key input value)

② Addition or subtraction of measured data sets when the OFFSET key is used
(Measured data) ± (Offset data)

External startup function

You can control the measurement startup from the rear panel for frequency, period or time interval measurement.

Input signal conditions: Measurement startup with the TTL level, positive slope edge signal

Input terminal: BNC connector on the rear panel (START SIGNAL port)

Mode: One of the following modes can be selected using the rear panel slide switch.

NORMAL: Starts measurement with the built-in timer (normal mode).
EXTERNAL: Starts measurement using the external measuring signals.
DELAYED EXTERNAL: Delays the start of measurement within the range of 5 to 50 msec after input of an external control signal. Use the EXT. START DELAY control on the front panel.

Monitor functions

Trigger level monitor: Monitors and displays the trigger level voltage of both INPUT A and INPUT B simultaneously when selected by the "LEV." level key. The signal level of INPUT A and INPUT B is displayed in 3-digit, 10 mV resolution.

Start/stop trigger monitor: Outputs the trigger points of both INPUT A and INPUT B to the TRIGGER MONITOR output terminal on the rear panel.
Approx. **-0.4 V**o-p (with 50-ohm termination); the trigger point is the positive slope edge.

External start delay time monitor: Monitors and displays the measurement start delay time (within 5 to 50 msec) when set by the MNR monitor and the "T.I" time interval key.

Self-diagnostic functions

10MHz check: Automatically executes the 10-MHz frequency check procedure and checks the normal system operation each time the system power supply is turned on.

Display check: Lights the monitor LED of each key and the display element and unit indicators of the fluorescent lamps on the front panel for checkout when set by the RST reset and MNR monitor keys.

Reference time

Internal reference frequency: 5 MHz

Internal reference output: Approximately 2 Vp-p of amplitude at 10MHz frequency and 50-ohm termination

Output terminal: BNC connector of STD-OUTPUT terminal on the rear panel

External reference input: 1 to 10 Vp-p of amplitude at 1, 2, 5 or 10-MHz frequency
Input impedance: Approx. 500 ohms
Input terminal: BNC connector of STD-INPUT terminal on the rear panel

Frequency stability:
Aging rate: 5×10^{-8}/day (**TR5830**)
5×10^{-10}/day (**TR5830D**)

Temperature characteristics (0 to 40°C): $\pm 1 \times 10^{-7}$ (**TR5830**)
$\pm 5 \times 10^{-9}$ (**TR5830D**)

Specifications

Measuring capacity: 12-digit decimal calculation

Display method: Numerical value storage and display on the fluorescent lamp indicator, character height 9.5 mm, green monochrome display, with brightness level adjustable at three levels using the rear panel BRIGHTNESS switch.

Annunciator:
"M": Indicates that measurement is in progress.
"-": Indicates negative polarity of display value.
"←": Indicates underflow of display value.

Sample rate time:	1 msec or less in the FAST SAMPLING mode. It can be set within 20 msec to 5 sec (continuous) using the SAMPLE RATE control, or it can be held.
External reset input:	TTL-level, negative slope edge BNC connector of RESET terminal on the rear panel
Display mask:	Up to 9 unnecessary low-order digits can be masked.
Oven on/off switching:	The oven power supply is turned on when the OVEN switch on the rear panel is set to ON.
Ambient environment:	Temperature: 0 to +40°C
Humidity:	85% or less
Storage temperature range:	-20 to +70°C
Power supply:	100 VAC ±10%, 50/60 Hz, approx. 200 VA (standard) (120 VAC, 200 VAC, 220 VAC ±10%, or 240 VAC +5%/-10% can be set.)
Dimensions:	425W×132H×550D mm
Weight:	Approx. 20 kg

MEMO

2. INSTALLATION PROCEDURE

2.1 Outline

This chapter explains the preparation and notes that you should use before measurement. It also explains the panel key and switch functions and their basic operations.

2.2 Preparation and Notes

2.2.1 Inspection

When the TR5830 universal counter is delivered, check it for any damage during transportation. Carefully check the panel switches and terminals.
If any system component is damaged or does not operate, contact the nearest dealership listed at the end of this manual.

2.2.2 Storage

If the counter is not to be used for a long time, cover it with a polyethylene sheet or place it in a fiberboard container and keep it in the dry and dark place.

2.2.3 Notes during transportation

Pack the counter in a standard container before transportation. If the original packing materials and container are lost, follow the instructions given below.

(1) Carefully wrap the counter with a thick polyethylene sheet.

(2) Place the counter in a 5-mm or thicker fiberboard container, and fix it with 50-mm or thicker packing material.

(3) Place the accessories in the same container and secure it with tough transportation string.

2.2.4 Notes before use

(1) Power supply
The system voltage has been set and is indicated at the power cable the rear panel. It is 100 VAC ±10% (120 VAC, 200 VAC, 220 VAC ±10%, or 240 VAC +5%/-10%). Use the counter at a power frequency of 50 Hz or 60 Hz.
CAUTION: Be sure to turn the **POWER** switch **OFF** before plugging the power cable into the wall socket.

(2) Power cable

The power cable has the 3-pin connector. The center round pin is the ground. When using a power adapter (KPR-13), connect the ground cable extending from the adapter (see Figure 2-1) to the ground, or connect the **GND** terminal on the counter rear panel to the external ground.

(3) Replacing the fuse

The power fuse is mounted on the fuse holder on the rear panel.
When replacing the fuse, rotate the fuse holder cap in the direction of the arrow and remove it.

Caution

Unplug the power cable from the wall socket before replacing the fuse.

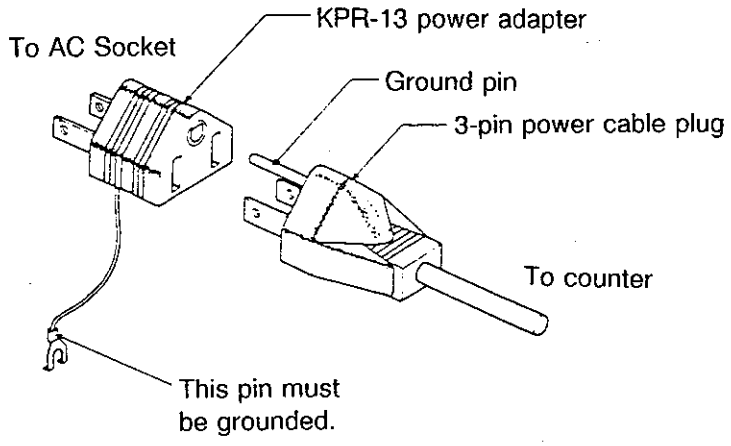


Figure 2-1 Power cable plug and adapter

(4) Operating environment

Keep the counter away from excessive dusts direct sunlight or corrosive gases. Use the counter in an ambient temperature of 0 to +40°C and humidity of 85% or less.

(5) Air cooling

The counter intakes through cooling air from the bottom air inlet and blows it out through the rear panel fan. Take care not to ensure asmooth air flow.

(6) Mechanical shock

As the counter contains a sensitive crystal oscillator and fluorescent lamp indicators, handle it with care so as not to apply excessive mechanical shock or vibration.

(7) Use of **OVEN** switch

When the **OVEN** switch **on** the rear panel is turned on and AC power is supplied to the counter, the **OVEN** lamp on the front panel remains lit even when the **POWER** switch is turned **off**. At this time, the crystal oscillator, thermostat heater and 10MHz multiplier circuit continue to operate. The 10MHz reference time signals are output from the "**STD. OUTPUT**" connector on the rear panel.

For measurement at the highest accuracy, always connect the power cable to the wall socket and keep the **OVEN** switch **ON**. This is because a certain pre-heating time is required before the crystal oscillator reaches the rated stable status after the thermostat heater has beenturned on.

(8) Selection of reference time signals

To use the reference time signals generated by the internal crystal oscillator, set the "**STD EXT./INT.**" selector on the rear panel to "**INT.**".

To enter the reference time signals from a peripheral, set this switch to "**EXT.**" and connect the reference time signal cable to the **INPUT** connector.

Select a frequency of either 1, 2, 5 or 10 MHz with an amplitude of 1 to 10 Vp-p. The signal stability must be equal or higher than that of the counter. The input impedance of the **INPUT** connector is approximately 500 ohms.

2.3 Panel Switches and LEDs

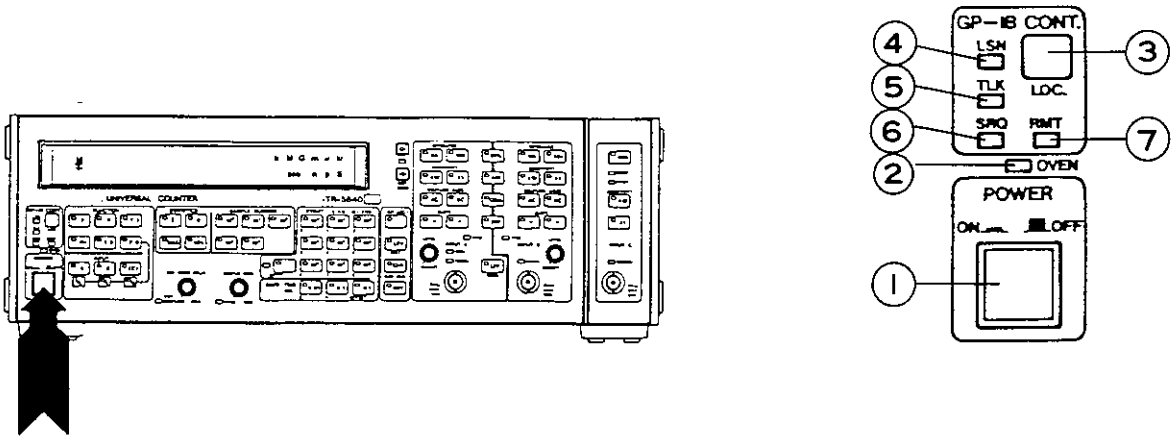


Figure 2-2 POWER and GPIB CONT. panels

① **POWER** switch
When the **POWER** switch is pressed, the power is supplied to the internal circuits and the counter starts operating. Pressing this button again turns the power supply **off**.
With the **OVEN** switch on the rear panel turned **ON**, the oscillator circuit, the 10MHz multiplier circuit and the thermostat heater are powered up when the power cable is plugged into the wall socket. The **OVEN** lamp remains lit.

② **OVEN** switch
With the **OVEN** switch on the rear panel turned **ON**, power continues to be supplied to the oscillator circuit, the 10MHz multiplier circuit and the thermostat heater independent of power switch ON/OFF unless the power cable is unplugged from the wall socket. The **OVEN** LED remains lit.

"GPIB CONT." panel

③ **LOC.** (local mode) switch
The "LOC." key switches the control mode between Remote Control and Local Control even when the GPIB or BCD data output and remote control unit have been mounted. The Local and Remote Control modes are selected alternately each time the "LOC." key is pressed.

④ **LSN** (Listen) LED
Lights when the counter is in listen status for GPIB interface.

⑤ **TLK** (talker) LED
Lights when the counter is in talker status.

⑥ **SRQ** (service request) LED
Lights when the counter issues a service request.

⑦ **RMT** (remote) LED
Lights when the counter is in Remote Control mode. This LED lights when the Remote Control mode is selected by switch ③, and goes out when the Local Control mode is selected.

FUNCTION and **INPUT** panels:

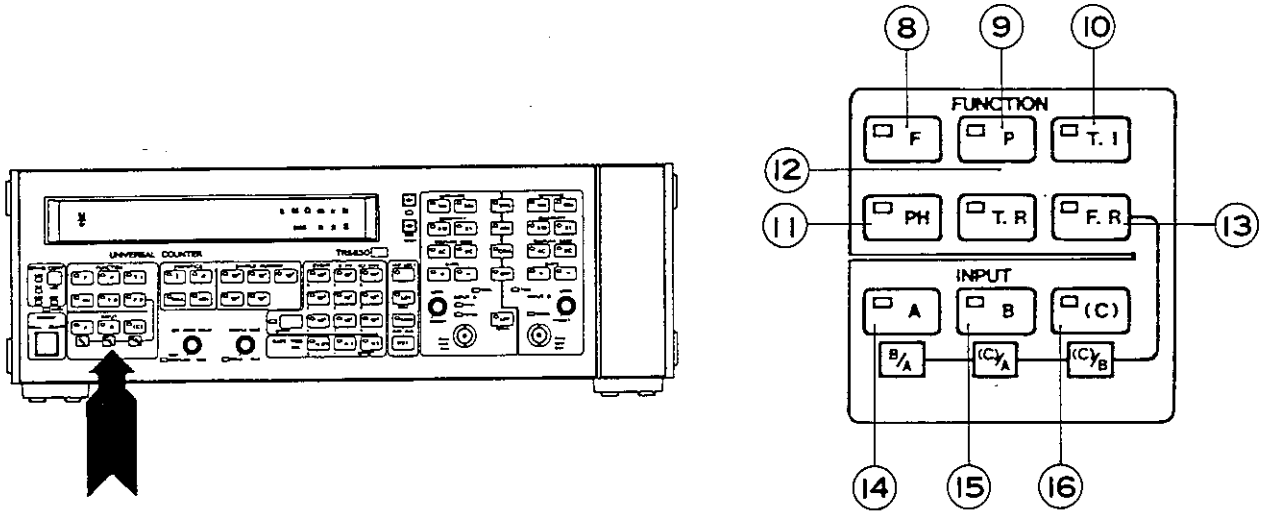


Figure 2-3 FUNCTION and INPUT panels

⑧ **F** (frequency) switch
This function switch is used for frequency measurement. When the F switch is pressed, the LED lights and the counter is set to signal frequency measuring status.

⑨ **P** (period) switch
This function switch is used for period measurement. When the P switch is pressed, the LED lights and the counter is set to period measuring status.

⑩ **T.I.** (time interval) switch
This function switch is used for time interval measurement. When the "T.I." switch is pressed, the counter is set to time interval measuring status.

⑪ **PH** (phase) switch
This function switch is used for signal phase measurement. When the PH switch is pressed, the LED lights and the counter is set to signal phase measuring status.

⑫ **T.R.** (time ratio) switch
This function switch is used for time ratio measurement. When the "T.R." switch is pressed, the LED lights and the counter is set to time ratio measuring status. The result is displayed as an exponential value.

⑬ **F.R.** (frequency ratio) switch
This function switch is used for frequency ratio measurement. When the "F.R." switch is pressed, the LED lights and the counter is set to frequency ratio measuring status. The result is displayed as an exponential value.

⑭ **A** switch (INPUT A)
This is a signal input terminal. When the A switch is pressed, both the switch and **10MHz** LEDs (see Item ⑦①) light.
If the "**F.R.**" switch (Item ⑬) has been turned on, the **B/A** status is set and both the 10MHz (Item ⑦①) and **100MHz** LEDs (Item ⑦③) light.

⑮ **B** switch (INPUT B)
This is a signal input terminal. When the **B** switch is pressed, both the switch and **100MHz** LEDs (see Item ⑦③) light.
If the "**F.R.**" switch (Item ⑬) has been turned on, the **C/A** status is set and both the **10MHz** (Item ⑦①) and **1000MHz** LEDs (Item ⑦③) light.

⑯ **C** switch (INPUT C)
This is the INPUT C (option 21) terminal. When the C switch is pressed both the switch and 1000MHz LEDs light.
If the "**F.R.**" switch (Item ⑬) has been turned on, the **C/B** status is set and both the **100MHz** (Item ⑦③) and **1000MHz** LEDs of **INPUT C** light.

STATISTICS and **SAMPLE NUMBER** panels

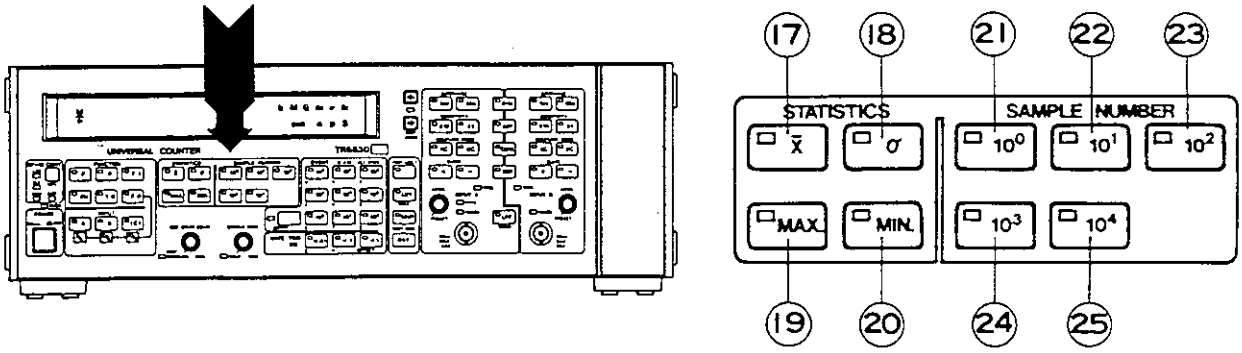


Figure 2-4 STATISTICS and SAMPLE NUMBER panels

⑰ $\bar{X}$ switch

Used to determine the average of the statistics operation. When this switch is pressed, the LED lights and the operation result is displayed.

⑱ σ switch

Used to determine the standard deviation of statistics operation. When this switch is pressed, LED lights and the operation result is displayed.

⑲ **MAX.** (maximum) switch

Used to determine the maximum value of statistics operation. When this switch is pressed, LED lights and the operation result is displayed.

⑳ **MIN.** (minimum) switch

Used to determine the minimum value of statistics operation. When this switch is pressed, LED lights and the operation result is displayed.

㉑ to ㉕ **SAMPLE NUMBER 10^0 to 10^4** switches

Used to set the collection data count during statistics operation.

"**10^0**" represents a single data set, "**10^1**" is 10 data sets, "**10^2**" is 100 data sets, "**10^3**" is 1,000 data sets, and "**10^4**" is 10,000 data sets. When one of these switches is pressed, the corresponding LED lights.

EXT. START DELAY and **SAMPLE RATE** controls

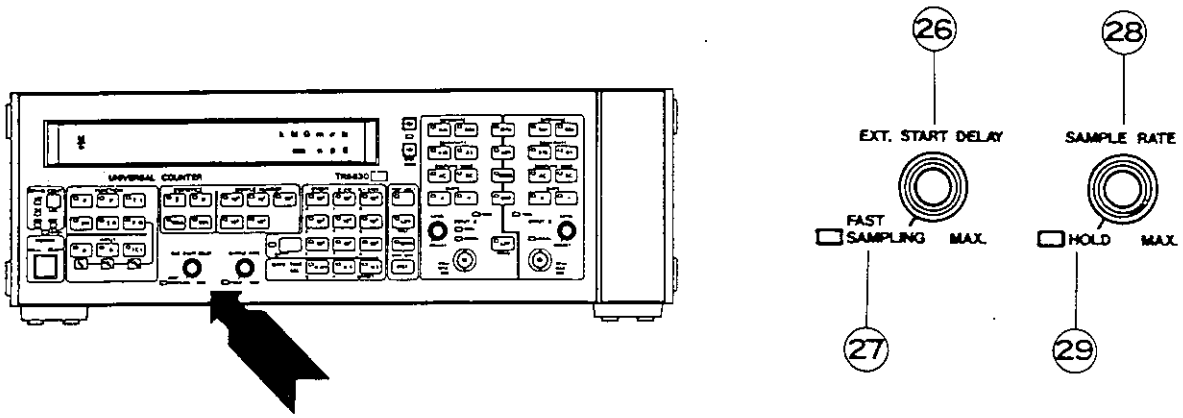


Figure 2-5 EXT. START DELAY and SAMPLE RATE controls

㉖ **EXT. START DELAY** control

This delay time control knob is effective when the **START SIGNAL** selector switch on the rear panel has been set to **DELAYED EXTERNAL**. The delay time can be changed from 5 to 50 msec continuously.

When the internal timer is used in **NORMAL** mode, the specified delay time is added to the sample rate time (set with switch ㉘). This control can be used for fine adjustment of the sample rate time. In the **EXTERNAL** mode, this delay time is ignored.

㉗ **FAST SAMPLING** control

When control ㉖ is fully rotated counterclockwise (CCW), the LED lights. At this time, the highest sampling rate is set, which is approximately 1 msec.

㉘ **SAMPLE RATE** control

Used to continuously adjust the measuring hold time within a range of 20 msec to 5 sec. When this control knob is rotated clockwise (CW), the iteration time is increased.

㉙ **HOLD** control

When control ㉘ is fully rotated counterclockwise (CCW), the LED lights. At this time, operation is stopped and the display is held. If measurement is in progress, the result is held only when it is completed.

Measurement can only be restarted by press the **RST** key or entering. The signal into the **RESET** connector on the rear panel. When the control knob is rotated clockwise (CW), the LED goes out and the hold status is released.

EVENT and **GATE TIME** panels

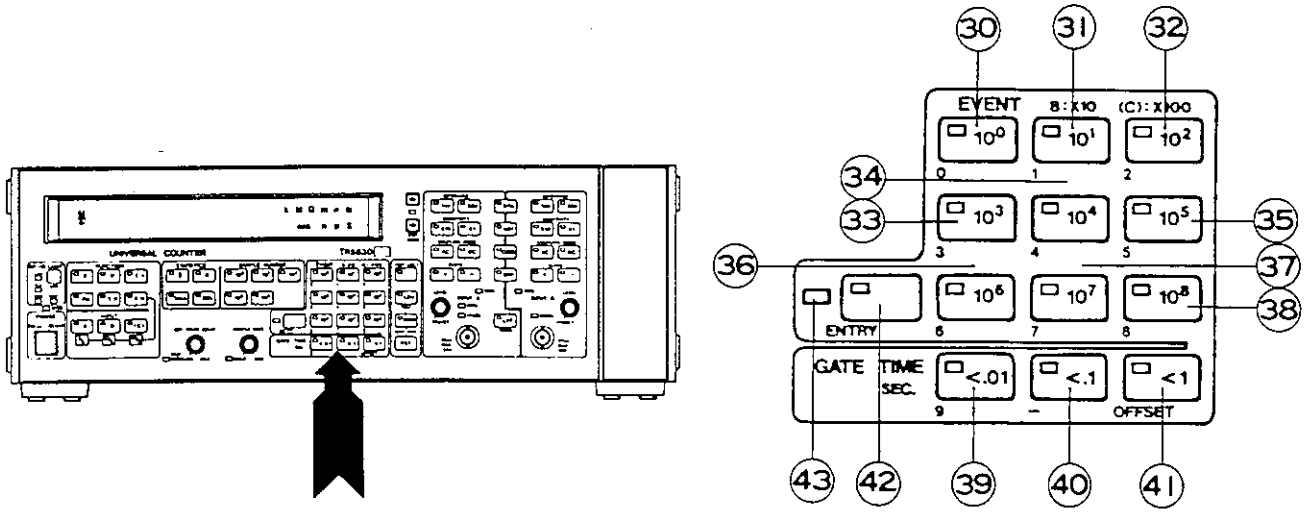


Figure 2-6 EVENT and GATE TIME panels

㉚ to ㊳ **EVENT 10^0 to EVENT 10^8**

The counter uses the reciprocal system for measuring the period, calculates the reciprocal value of 1/period, and displaying the frequency. The EVENT represents the iteration count of signals used during measurement. The display resolution (the number of display digits) for period measurement is determined as follows:

(EVENT number)x(Single input period time)/(100 psec)

This expression can also be used for frequency measurement. When the INPUT A terminal is used, any numerical value from s **10^0** to **10^8** can be set as indicated on the key top. When the INPUT B terminal is used, the value multiplied by 10 (10^1 to 10^9) is set. When the INPUT C terminal is used, the value multiplied by 100 (10^2 to 10^{10}) is set. When one of the switches is pressed, the corresponding LED lights.

㊴ to ㊶ **GATE TIME SEC.**

<.01 Indicates the gate time of 0.01 sec or less. When this switch is pressed, the LED lights and the gate time is set within a range of 0.001 to 0.01 sec (depending on the measuring frequency). The current EVENT number is displayed on LEDs ㉚ to ㊳ . The same applies for the following.

<.1 0.1 sec or less. When this switch is pressed, LED lights and the gate time is set within a range of 0.01 to 0.1 sec.

<1 1 sec or less. When this switch is pressed, the LED lights and the gate time is set within a range of 0.1 to 1 sec.

㊷ **ENTRY** switch

When this switch is pressed, LED ㊸ lights and the functions of switches ㉚ to ㊶ are changed to those indicated at the lower left of each key top. When **ENTRY** is pressed again, LED ㊸ goes out and the functions of switches ㉚ to ㊶ are reset to the **EVENT** and **GATE TIME** functions.

The following illustrates the change of each switch function.

10^0	→ 0	10^4	→ 4	10^8	→ 8
10^1	→ 1	10^5	→ 5	<.01	→ 9
10^2	→ 2	10^6	→ 6	<.1	→ –
10^3	→ 3	10^7	→ 7	<1	→ OFFSET

0 to 9: Numeric keys

-: Changes the input polarity each time this key is pressed.

OFFSET:Stores the previously measured value as an addend or subtracter.

㊸ **ENTRY** switch LED

When this LED lights, the functions illustrated above are selected.

Note: Except in the MNR mode, the ENTRY function can only be used with the F, P or "T.I." switch. Otherwise, an E003 error message is output. If you attempt to add or subtract data sets having different units (Hz or sec), an E002 error message is output.

"**DISP. MASK**" and **MNR** (monitor) panels

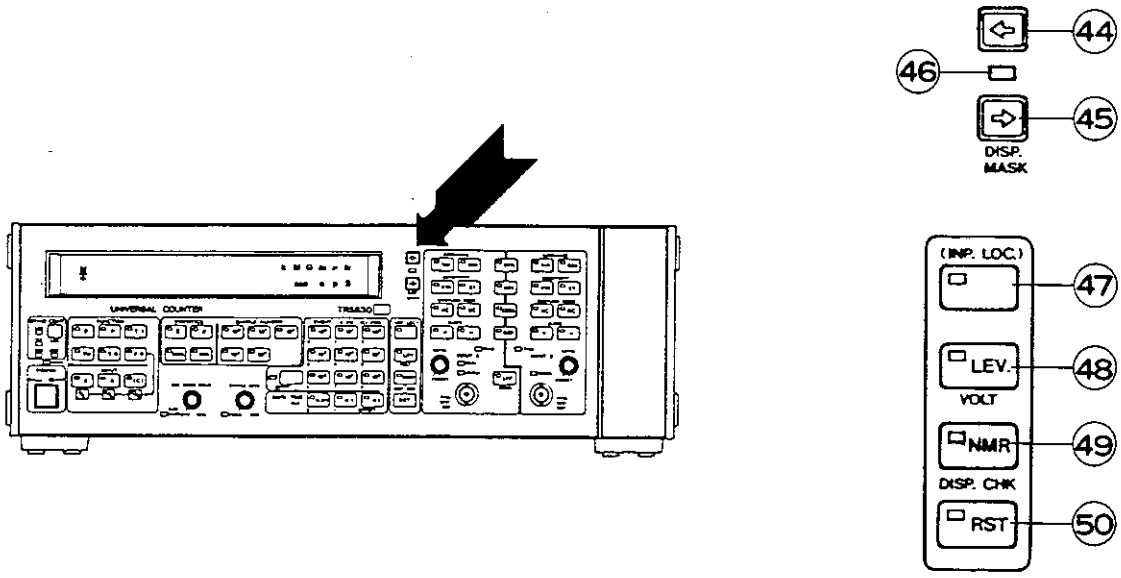


Figure 2-7 "DISP. MASK" and MNR (monitor) panels

㊹ **DISP. MASK** ← (display masking) switch
When this switch is pressed once, one digit of the fluorescent display is masked. Up to nine unnecessary low-order digits can be masked.

㊺ **DISP. MASK** → (display masking) switch
When this switch is pressed once, the fluorescent display digit that was masked is released.

㊻ Display masking indication LED
This LED lights when one or more digits of the fluorescent display are masked. When they are all released by switch ㊺ this LED goes out.

㊼ (**INP. LOC.**) (input local) switch
Used to select the manual mode. This allows you to set the input conditions of **INPUT A**, **INPUT B** and **INPUT C** using the front panel switches in manual mode.
When this switch is pressed, the corresponding LED lights. If the GPIB data output and remote control function are not used, this LED remains on regardless of the switch setup.

㊽ **LEV.** (level) switch
Used for trigger level monitoring. When this switch is pressed, the corresponding LED lights and the monitor interval is indicated on the fluorescent display. The left three digits indicate the trigger level of **INPUT A**, and the right three digits, the trigger level of **INPUT B**. The display unit is volts, and the decimal point is fixed.

㊾ **MNR** (Monitor) switch

Used for counter operation checks. When this switch is pressed, the corresponding LED lights. For details of the operation checks using the **MNR** switch, see Section 2.4.2.

㊿ **RST** (reset) switch

Used to manually reset the counter. During normal measurement, the display values are all zeroed when the RST switch is held down. When the switch is released, the next measurement starts.

However, when the RST switch is held down in the MNR mode, the LEDs of each display element, unit and switch remain on and "**DISP. CHK**" (display check) mode is selected. When this switch is released, the next measurement starts.

Input condition panel

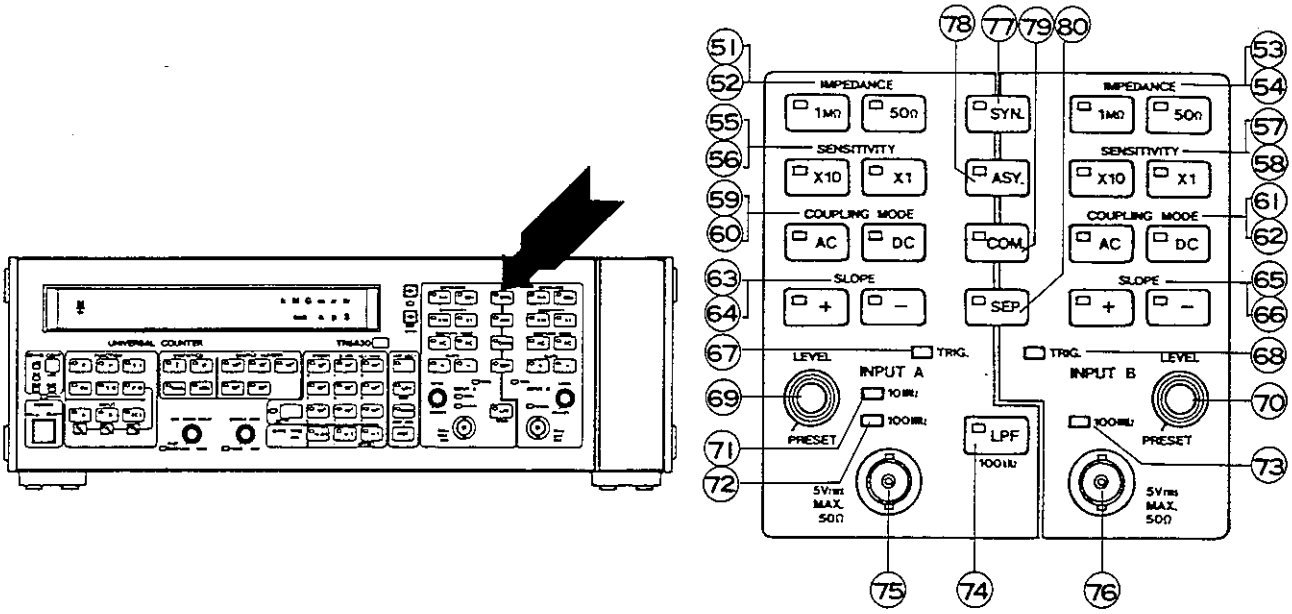


Figure 2-8 Input condition panel

(51) **IMPEDANCE 1-megaohm** switch

(52) **IMPEDANCE 50-ohm** switch
Select the input impedance of **INPUT A**. When one of these switches is pressed, the corresponding LED lights.

(53) **IMPEDANCE 1-megaohm** switch

(54) IMPEDANCE 50-ohm switch
Select the input impedance of **INPUT B**. When one of these switches is pressed, the corresponding LED lights.

(55) **SENSITIVITY × 10** switch

(56) **SENSITIVITY x1** switch
Select the input sensitivity of **INPUT A**. "**× 10**" sets the 1.4 Vp-p (0.5 Vrms) sensitivity, and "**× 1**" sets the 140 mVp-p (50 mVrms) sensitivity. When one of these switches is pressed, the corresponding LED lights.
Since these switches operate as attenuators for signals under test, they must be set for the appropriate trigger points.

⑰ **SENSITIVITY × 10** switch

⑱ **SENSITIVITY × 1** switch
Select the input sensitivity of INPUT B. "**× 10**" sets the 1.4 Vp-p (0.5 Vrms) sensitivity, and "**× 1**" sets the 140 mVp-p (50 mVrms) sensitivity. When one of these switches is pressed, the corresponding LED lights.
Since these switches operate as attenuators for signals under test, they must be set for the appropriate trigger points.

⑲ **COUPLING MODE AC** switch

⑳ **COUPLING MODE DC** switch
Set the input coupling mode of **INPUT A** for signals under test. Switch ⑲ sets **AC** coupling, and tswitch ⑳ sets **DC** coupling. When the switch is pressed, the corresponding LED lights.

㉑ **COUPLING MODE AC** switch

㉒ **COUPLING MODE DC** switch
Set the input coupling mode of **INPUT B** for signals under test.
Switch ⑲ sets **AC** coupling, and switch ⑳ sets **DC** coupling.
When the switch is pressed, the corresponding LED lights.

㉓ **SLOPE** + switch

㉔ **SLOPE** - switch
Set the trigger point of the signal under test of **INPUT A** to positive or negative slope. When the switch is pressed, the corresponding LED lights.
These switches are usually used to set the trigger point during time period measurement.

㉕ **SLOPE** + switch

㉖ **SLOPE** - switch
Set the trigger point of the signal under test of **INPUT B** to positive or negative slope. When the switch is pressed, the corresponding LED lights.
These switches are usually used to set the trigger point during time period measurement.

㉗ **TRIG.** (trigger) indicator
The "**TRIG.**" indicator lamp lights when the signal under test sent to the **INPUT A** connector is higher than the voltage of the input sensitivity and when it reaches the trigger level set by switch ㉙ .

㉘ **TRIG.** (trigger) indicator
The "**TRIG.**" indicator lamp lights when the signal under test sent to the **INPUT B** connector is higher than the voltage of the input sensitivity and when it reaches the trigger level set by switch ㉚ .

⑥⑨ **LEVEL** control

This control knob is used to continuously change the trigger point of the signal under test sent to **INPUT A**. If the **SENSITIVITY** switch has been set to "×1", this control continuously changes the trigger level between -1.6 VDC and +1.6 VDC. If set to "×10", it continuously changes the trigger level between -16 VDC and +16 VDC. When the control is fully rotated counterclockwise (CCW), the voltage is set to the **PRESET** level (0 VDC). When triggered, indicator ⑥⑦ lights. When "**LEV.**" switch ④⑧ is pressed, the voltage can be monitored. (If "×10" has been set, the voltage divided by 10 is displayed.)

⑦⓪ **LEVEL** control

This control knob is used to continuously change the trigger point of the signal under test sent to **INPUT B**. If the **SENSITIVITY** switch has been set to "x1", this control continuously changes the trigger level between -1.6 VDC and +1.6 VDC. If set to "x10", it continuously changes the trigger level between -16 VDC and +16 VDC. When the control is fully rotated counterclockwise (CCW), the voltage is set to the **PRESET** level (0 VDC). When triggered, indicator ⑥⑧ lights. When "**LEV.**" switch ④⑧ is pressed, the voltage can be monitored. (If "x10" has been set, the voltage divided by 10 is displayed.)

⑦① **10MHz** LED

The 10MHz LED lights when:

The "**F**" or "**P**" **FUNCTION** option and **INPUT A** are set.

The "**F.R.**" **FUNCTION** option and **B/A** or **C/A** are set.

When this LED is on, measurement at input A can be made. The upper measuring frequency limit is 10 MHz.

⑦② **100MHz** LED

When the 100MHz LED is on, measurement at input A can be made. The upper measuring frequency limit is 100 MHz.

This LED lights when the "**T.I.**", "**PH**", or "**T.R.**" **FUNCTION** option is set.

⑦③ **100MHz** LED

When the 100MHz LED is on, measurement at input B can be made. The upper measuring frequency limit is 100 MHz.

This LED lights when:

The "**F**" or "**P**" **FUNCTION** option and **INPUT B** are set.

The "**F.R.**" **FUNCTION** option and **B/A** or **C/A** are set.

The "**T.I.**", "**PH**", or "**T.R.**" **FUNCTION** option and "**SEP.**" are set.

⑦④ **LPF** (low-pass filter) switch

Used to set the 100kHz input bandwidth of **INPUT A**. This switch should be used if 100kHz signals or less have large multiplex RF noise. When this switch is pressed, the corresponding LED lights.

⑮ **INPUT A** connector
This BNC connector can only be used when the 10MHz ⑪ or 100MHz LED ⑫ is on.

⑯ **INPUT B** connector
This BNC connector can only be used when the 100MHz LED ⑬ is on.

⑰ **SYN.** (synchronous) switch
This switch allows positive or negative time interval measurement when the **FUNCTION** is set to "**T.I.**". This switch is usually used in the "**COM.**" mode. When pressed, the LED lights.
When the FUNCTION is set to "**F**", "**P**" or "**F.R.**" and this switch is pressed, the second signal is used to start measurement.

⑱ **ASY.** (asynchronous) switch
When the **FUNCTION** is set to "**T.I.**" and this key switch is pressed, only the positive time interval is displayed. This switch is used for single pulse signals or in the "**SEP.**" mode. The minimum measuring pulse width is approximately 10 nsec. If a signal having a smaller pulse width is entered, counter operation stops when the edge of the subsequent signal is detected. **INPUT A** is used as the start channel, and **INPUT B** as the stop channel. When the switch is pressed, the LED lights. When the **FUNCTION** is set to "**F**", "**P**" or "**F.R.**" and this switch is pressed, the first signal is used to start measurement.

⑲ **COM.** (common) switch
When the **FUNCTION** is set to "**T.I.**", "**PH**" or "**T.R.**" and this switch is pressed, the **INPUT A** connector is used as the common terminal for both start and stop signal input. The impedance, sensitivity and coupling mode can be set at **INPUT A**. However, the trigger slope and trigger level can be set separately at **INPUT A** and **INPUT B**. When the "**T.I.**" function is set, this switch is used for time interval measurement of single measuring signals under test (such as signal rise or fall time and pulse width measurement). When the "**T.R.**" function is set, this switch is used for duty ratio measurement. When this switch is pressed, the corresponding LED lights.

⑳ **SEP.** (separate) switch
When this switch is pressed, the **INPUT A** and **INPUT B** connectors are used for separate signal input. The signal input conditions of connectors A and B can be set at each input side. When this switch is pressed, the corresponding LED lights.

Display panel

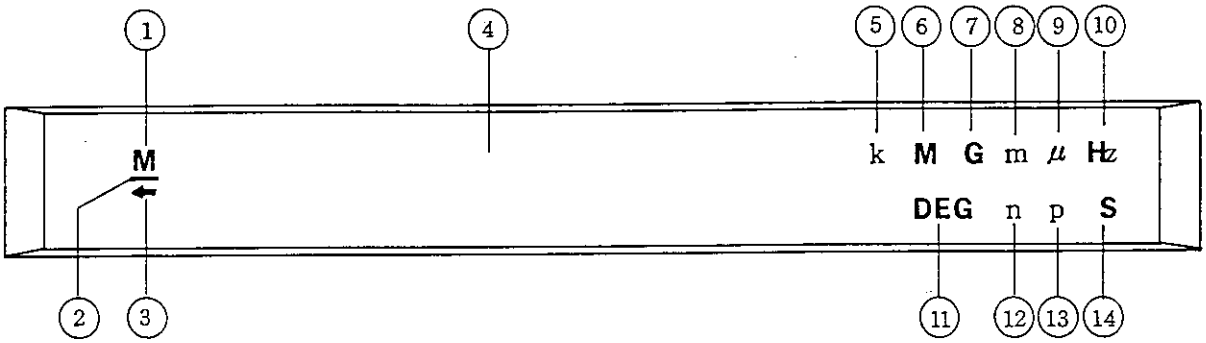


Figure 2-9 Display panel

① **M** (measurement): Indicates that measurement is in progress on the counter.

② "-" (negative sign): Indicates a negative value. (*1)

③ ← (underflow): Indicates an underflow value. (*2)

④ 12-digit fluorescent lamp indicator; 9.5-mm character height; monochrome green display

⑤ **k** (kilo): 10^3

⑥ **M** (mega): 10^6

⑦ **G** (giga): 10^9

⑧ **m** (milli): 10^{-3}

⑨ **μ** (micro): 10^{-6}

⑩ **Hz** (hertz)

⑪ **DEG** (degrees)

⑫ **n** (nano): 10^{-9}

⑬ **P** (pico): 10^{-12}

⑭ **S** (seconds)

*1 Also indicates the result of subtraction.

*2 Indicates that an overflow has occurred during addition or subtraction.

Rear panel

① Power cable
Plugged into the AC power socket.

② **LINE T3.15A** fuse
The counter power fuse. An EAWK 3.15A (OLVIS) fuse is used for the 100 VAC and 120 VAC models, while an EAWK 2.0A (OLVIS) time lag fuse is used for the 200 VAC, 220 VAC and 240 VAC models.

③ **OVEN T0.25A** fuse
The oven circuit fuse of the built-in reference time generator. An EAWK 0.25A (OLVIS) fuse is used for the 100 VAC and 120 VAC models, while an EAWK 0.125A (OLVIS) time lag fuse is used for the 200 VAC, 220 VAC and 240 VAC models.

④ **GND** terminal
When attaching a two-pin power adapter to the power cable plug, the ground lead of the adapter must be connected to this GND terminal, or the leads of this GND terminal grounded (see Figure 2-1).

⑤ **STD INPUT** (standard input) connector
Used to enter the external reference signal into the counter.
The external reference signal must be 1MHz, 2MHz, 5MHz or 10MHz with a voltage of 1 Vp-p to 10 Vp-p. The input impedance is approximately 500 ohms.

⑥ **STD OUTPUT** (standard output) connector
If the "**EXT./INT.**" switch has been set to "**INT.**", with internal reference signals (10 MHz approximately 2 Vp-p amplitude and 50-ohm termination) are output. If set to "**EXT.**", 10MHz signals generated from the external reference signals are output.

⑦ **STD** selector switch
Used to select either the internal crystal oscillator (**INT.**) for generating the reference time signals or external reference signal input (**EXT.**).
When the switch is set to "**INT.**", the internal crystal oscillator is used for signal generation.
When the switch is set to "**EXT.**", the counter operates with external 1MHz, 2MHz, 5MHz or 10MHz reference time signals.

⑧ **INT. X'TAL ADJ.** (internal crystal adjustment)
Used to calibrate the crystal oscillator which generates internal reference signals.

⑨⑩ TRIGGER MONITOR OUTPUTS

The monitor signal output terminals of INPUT A and B trigger points. They are BNC connectors and their voltage is approximately -0.4 $V_{0\text{-}p}$ (with 50-ohm termination). The trigger point is output with the positive slope edge. Terminal ⑨ is the INPUT A output, and terminal ⑩, the INPUT B output.

⑪ **RESET** terminal

The external reset signal input terminal. This is the BNC connector for TTL level signals. The counter is reset by the negative slope edge of the external input signal.

⑫ START SIGNAL

The external start mode selector switch which functions as follows.

NORMAL: Starts measurement with the built-in timer in normal mode.

EXTERNAL: Starts measurement with an external control signal.

DELAYED EXTERNAL: Allows a continuous time delay from 5 to 50 msec by using the **"EXT. START DELAY"** control on the front panel. Measurement startup is delayed for the specified time after input of the external control signal. The specified delay time can be displayed on the fluorescent lamp when the **"MNR"** and **"T.I."** switches on the front panel are pressed.

⑬ **START SIGNAL** connector

The input terminal of an external control signal. This is the BNC connector for TTL level signals. Measurement is started by the positive slope edge of the external control signal.

⑭ Cooling fan

The counter cooling fan. The air flows from the bottom air inlet to the rear panel fan. Take care not to interrupt the smooth air flow.

⑮ **BRIGHTNESS** control

Used to adjust the brightness level of the fluorescent lamps. It can be set to **HIGH**, **MEDIUM** or **LOW** according to the ambient conditions.

⑯ **OVEN** switch

The power switch of the thermostat heater and the 10MHz multiplexer circuit of the crystal oscillator.

When this **OVEN** switch is turned **on** and the AC power cable is plugged into the power socket, the **OVEN** indicator on the front panel remains lit and both the thermostat heater and the 10MHz multiplexer circuit of the crystal oscillator continue to operate even when the front panel **POWER** switch is turned **off**.

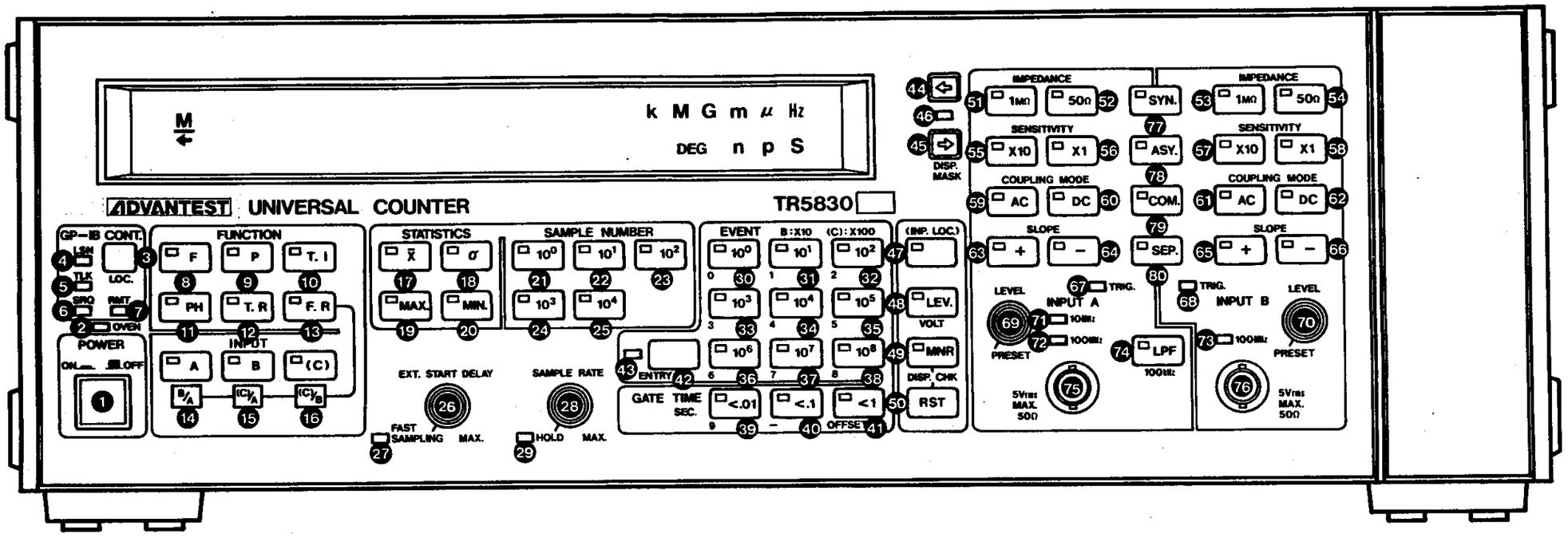


Figure 2-10 Front panel drawing

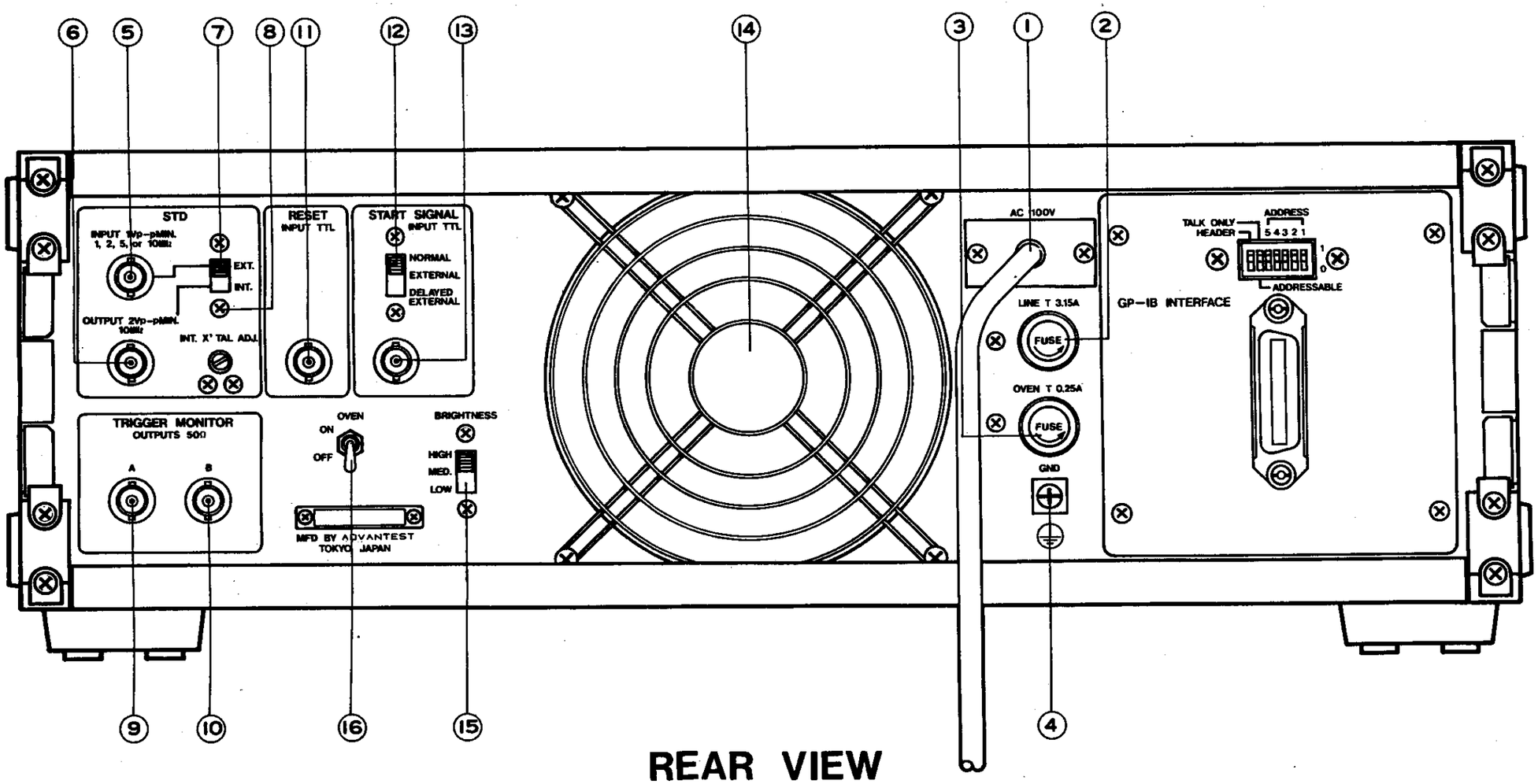


Figure 2-11 Rear panel drawing

2.4 Basic Operations

This section explains the basic counter operations. It can also be used to roughly check normal counter operation.

(1) Make sure that the power voltage matches that printed on the rear panel nameplate. Also, make sure that the correct fuse is mounted in its holder (see the table below).

100 VAC power:	LINE	3.15A fuse
	OVEN	0.25A fuse
200 VAC power:	LINE	2.0A fuse
	OVEN	0.125A fuse

Make sure that the front panel **POWER** switch is turned off and the **OVEN** switch on the rear panel is turned **off**. Then, plug the power cable into the power socket.

(2) Turn the **OVEN** switch **on** and make sure that the **OVEN** lamp lights.
To use the internal crystal oscillator for reference time signal generation, set the "**STD EXT. INT.**" selector to "**INT.**". To use the external reference time signals, set the selector to "**EXT.**" and enter the reference time signals into the **STD INPUT** connector.
Make sure that the **START SIGNAL** switch on the rear panel is set to **NORMAL**.
Now, you can turn the **POWER** switch **on**.

2.4.1 Inspection and operation checks after **power-on**

(a) Make sure that the **HOLD** LED of the **SAMPLE RATE** is off.

(b) Make sure that the "**DISP. MASK**" indicator is off.

(c) The following lists the initial parameter setup when the **POWER** switch is turned **on**. Make sure that the LEDs of the corresponding switches light.

(INP. LOC)	The LED lights
FUNCTION	**F** (The LED lights)
INPUT	**A** (The LED lights)
STATISTICS	All LEDs go out
SAMPLE NUMBER	10^0 (The LED lights)
GATE TIME	**<.01** (The LED lights)
MNR	The LED lights

Input conditions to **INPUT A**:

IMPEDANCE	**1 M**ohms (The LED lights)
SENSITIVITY	**×10** (The LED lights)
COUPLING MODE	**AC** (The LED lights)
SLOPE	+ (The LED lights)
10MHz/100MHz	**10M**Hz (The LED lights)
SYN.	The LED lights

Display section:
Character M blinks.
Fluorescent lamp 10.000000
Unit MHz

(d) Make sure that all display panel lamps light in the "**DISP. CHK**" mode (selected by the **MNR** and **RST** switches) and that all front panel monitor LEDs light.

Caution

If the initial parameters are not set when the **POWER** is turned **on**, press the **RST** switch.

2.4.2 Checking each function

(1) **F** (frequency measurement) check
Set the front panel switches as follows:

FUNCTION	**F** (The LED lights)
DISP. CHK	**MNR** (The LED lights)
Input conditions	**SYN.** (The LED lights)
SAMPLE NUMBER	**10^0** (The LED lights)
SAMPLE RATE	Rotate CCW to the point immediately before the **HOLD** position

(a) Set the **INPUT** to "**A**" and check the following.

GATE TIME (SEC.) **<.01**

M 9.999996 ~ 10.000004 MHz

GATE TIME (SEC.) **<.1**

M 9.9999996 ~ 10.0000004 MHz

GATE TIME (SEC.) **<1**

M 9.99999996 ~ 10.00000004 MHz

EVENT 10^0

M 9.96 ~ 10.04 MHz

EVENT 10^1

M 9.996 ~ 10.004 MHz

EVENT 10^2

M 9.9996 ~ 10.0004 MHz

EVENT 10^3

M 9.99996 ~ 10.00004 MHz

EVENT 10^4

M 9.999996 ~ 10.000004 MHz

EVENT 10^5

M 9.9999996 ~ 10.0000004 MHz

EVENT 10^6

M 9.99999996 ~ 10.00000004 MHz

EVENT 10^7

M 9.999999996 ~ 10.000000004 MHz

EVENT 10^8

M 9.9999999996 ~ 10.0000000004 MHz

(b) Set the **INPUT** to "**B**" and check the display in the same way as for (a).
The floating point moves as follows.
Example: **GATE TIME (SEC.)** **<.01**

M 99.99996 ~ 100.00004 MHz

(c) Set the **INPUT** to "**C**" and check the display in the same way as for (a).
The floating point moves as follows.
Example: GATE TIME (SEC.) **<.01**

M 999.99996 ~ 1.00000004 MHz

(2) **P** (period measurement) check

Set the front panel switches as follows:

FUNCTION	**P** (The LED lights)
DISP. CHK	**MNR** (The LED lights)
Input conditions	**SYN.** (The LED lights)
SAMPLE NUMBER	10^0 (The LED lights)
SAMPLE RATE	Rotate CCW to the point immediately before the **HOLD** position

(a) Set the **INPUT** to "**A**" and check the following.

GATE TIME (SEC.) <.01

M 99.999996 ~ 100.000004 ns

GATE TIME (SEC.) <.1

M 99.9999996 ~ 100.0000004 ns

GATE TIME (SEC.) <1

M 99.99999996 ~ 100.00000004 ns

EVENT 10^0

M 99.6 ~ 100.4 ns

EVENT 10^1

M 99.96 ~ 100.04 ns

EVENT 10^2

M 99.996 ~ 100.004 ns

EVENT 10^3

M 99.9996 ~ 100.0004 ns

EVENT 10^4

M 99.99996 ~ 100.00004 ns

EVENT 10^5

M 99.999996 ~ 100.000004 ns

EVENT 10^6

M 99.9999996 ~ 100.0000004 ns

EVENT 10^7

M 99.99999996 ~ 100.00000004 ns

EVENT 10^8

M 99.999999996 ~ 100.000000004 ns

(b) Set the **INPUT** to "**B**" and check the display in the same way as for (a).
The floating point moves as follows.
Example: **GATE TIME (SEC.)** **<.01**

M 9.9999996 ~ 10.000004 ns

(c) Set the **INPUT** to "**C**" and check the display in the same way as for (a).
The floating point moves as follows.

M 999.99996 ~ 1.000000004 ns

Example: **GATE TIME (SEC.)** **<.01**

M 999.99996 ps 1.000000004 ns

(3) "**T.I.**" (time interval measurement) check
Set the front panel switches as follows:

FUNCTION	**T.I.** (The LED lights)
DISP. CHK	**MNR** (The LED lights)
SAMPLE NUMBER	**10^0** (The LED lights)
SAMPLE RATE	Rotate CCW to the point immediately before the **HOLD** position

(a) Rotate the "**EXT. START DELAY**" control counterclockwise (CCW) to the position immediately before the **FAST SAMPLING** switch position. Make sure that the display is 5 msec or less.

M 5.000000 ms
↑ 100-psec digit

(b) Rotate the "**EXT. START DELAY**" control clockwise (CW) until the display becomes 50 msec or less (**MAX.**).

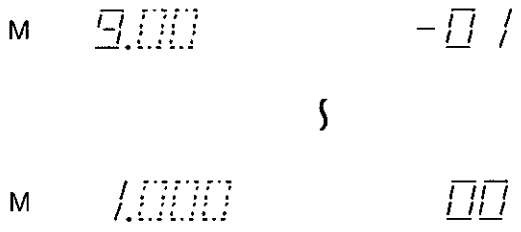
M 50.000000 ms
↑ 100-psec digit

(4) "**T.R.**" (time ratio measurement) check

Set the front panel switches as follows:

FUNCTION	**T.R.** (The LED lights)
DISP. CHK	**MNR** (The LED lights)
Input conditions	**COM.** (The LED lights)
SAMPLE NUMBER	10^0 (The LED lights)
SAMPLE RATE	Rotate CCW to the point immediately before the **HOLD** position

Make sure that the following is displayed.



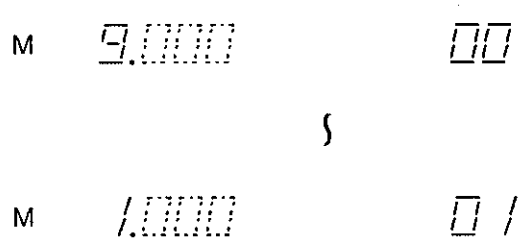
and

(5) "**F.R.**" (frequency ratio measurement) check

Set the front panel switches as follows:

FUNCTION	**F.R.** (The LED lights)
DISP. CHK	**MNR** (The LED lights)
EVENT	10^0
SAMPLE RATE	Rotate CCW to the point immediately before the **HOLD** position

(a) Make sure that the following is displayed when the **INPUT** is set to **B/A** or **C/B**.



(b) Make sure that the following is displayed when the **INPUT** is set to **C/A**.

M 9.000 0 /

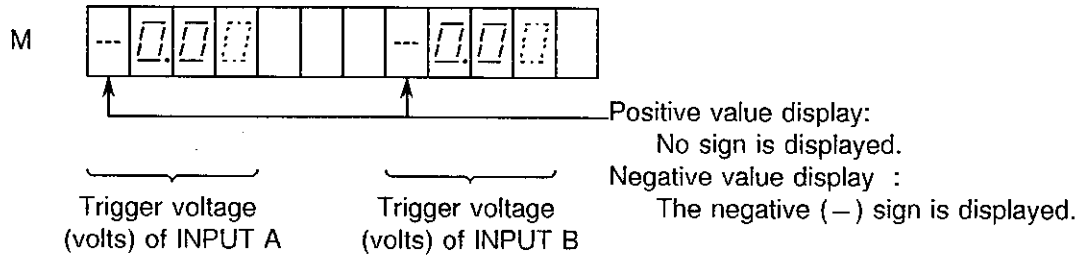
⟆

M 1.000 02

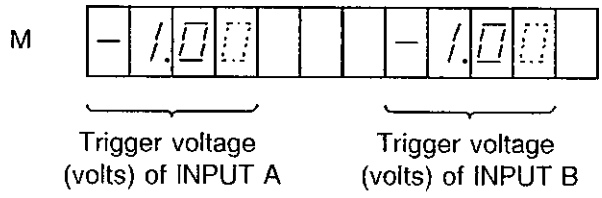
(6) **PH** (Phase measurement) check
See Section 2.9 "Phase Measurement".

(7) "**LEV.**" check
Press the "**LEV.**" switch on the front panel, and the corresponding LED will light.
Note: Make sure that the "**DISP. MASK**" indicator is off.

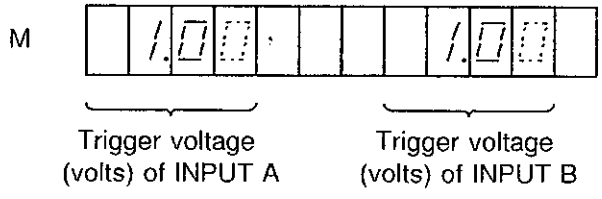
(a) If the trigger level is set to **PRESET**
Rotate the **INPUT A - LEVEL** and **INPUT B - LEVEL** controls CCW to their **PRESET** position and make sure that the following is displayed.



(b) If the trigger level is set to "-1.0V"
Rotate the **INPUT A - LEVEL** and **INPUT B - LEVEL** controls CCW to their **PRESET** position and make sure that the following is displayed.



(c) If the trigger level is set to " + 1.0V"
Fully rotate the **INPUT A - LEVEL** and **INPUT B - LEVEL** controls clockwise (CW) and make sure that the following is displayed.



(8) **STATISTICS** (statistics operation) check

Set the front panel switches as follows:

FUNCTION	**P** (The LED lights)
EVENT	10^0
DISP. CHK	**MNR** (The LED lights)
ENTRY indicator	Make sure the lamp is off
INPUT	**A** (The LED lights)

(a) Set the **SAMPLE RATE** to any position except **HOLD**.
Make sure that the following **STATISTICS** parameters are set for each **SAMPLE NUMBER**.

STATISTICS	SAMPLE NUMBER			
	10^1	10^2	10^3	10^4
$\overline{X}$	M 100.40 nsec or less M 99.60 nsec or more	M 100.40 nsec or less M 99.60 nsec or more	M 100.400 nsec or less M 99.600 nsec or more	M 100.400 nsec or less M 99.600 nsec or more
σ	M 0.10 nsec or less	M 0.100 nsec or less	M 0.1000 nsec or less	M 0.1000 nsec or less
MAX.	M 100.4 nsec or less	M 100.4 nsec or less	M 100.4 nsec or less	M 100.4 nsec or less
MIN.	M 99.6 nsec or more	M 99.6 nsec or more	M 99.6 nsec or more	M 99.6 nsec or more

(b) Set the **SAMPLE RATE** to the **HOLD** position and make sure that the indicator lights. Then, perform the following.

① Set the **SAMPLE NUMBER** to "10^2", for example (and set the other parameters in the same way as for (a)).

② Press the **RST** switch.

③ Make sure that the **M** indicator goes out.

④ Press any of the **STATISTICS** switches, and the statistics result of the specified **SAMPLE NUMBER** will be displayed. The display is the same as that shown in (a).

Note: Do not change the **SAMPLE NUMBER** after Step ③.

2.4.3 Error message display

(1) If an operation error occurs, the counter displays one of the following error messages. In this case, repeat the operation correctly.

a

Error simulation example:

①	**FUNCTION**	**T.I.** (The LED lights)
②	**SAMPLE NUMBER**	**10^0** (The LED lights)
③	Input conditions	**ASY, SEP.** (Each LED lights)
④	**MNR**	Released (The LED goes out)

If the above switches are set, the **LEVEL** control of **INPUT A** is rotated to start measurement, and if the **LEVEL** control of **INPUT B** is rotated to stop measurement after 1,000 seconds or more, this error message is output indicating an overflow.

b

This error message is output if an invalid addend or subtracter data is set in the **ENTRY** mode (for example, different basic unit setup).

Error simulation example:

①	**EVENT**	**10^0** (The LED lights)
②	**SAMPLE NUMBER**	**10^0** (The LED lights)
③	**FUNCTION**	**P** (The LED lights)
④	**INPUT**	**A** (The LED lights)
	If 10Hz is entered via **INPUT A** connector, for example:	
⑤	**MNR**	Released (The LED goes out)
⑥	Display check of **M** 100.0000 μsec	
⑦	Press **ENTRY** and make sure that the corresponding indicator lights.	
⑧	Press **OFFSET**.	
⑨	Set the **FUNCTION** to "F".	

⑩ Press **ENTRY** and make sure that the corresponding indicator goes out.

If the above operation is executed, error message "b" is output.

This error occurs because the addend or subtracter data of 100.0000 usec has been stored in Step ⑧ but was changed to "**F**" in Step ⑨. The augend or minuend data has been set to 10.00000 kHz and the basic units do not match.

c

This error message is output when an operation error occurs in the **ENTRY** mode.

The **ENTRY** mode cannot be selected when either the "**PH**", "**T.R.**" or "**F.R.**" **FUNCTION** option or "**MNR**" or "**LEV.**" is set.

Error simulation example (during **MNR** setup):

① Set the **MNR**.

② Press **ENTRY**.

When this operation is executed, the message c is output.

d

This error message is output when an invalid operation is made during statistics calculation.

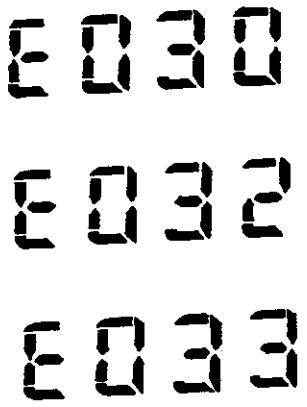
Error simulation example:

①	**FUNCTION**	**F** (The LED lights)
②	**EVENT**	10^2 (The LED lights)
③	**SAMPLE NUMBER**	10^3 (The LED lights)
④	**STATISTICS**	σ (The LED lights)
⑤	**SAMPLE RATE**	**HOLD** (The indicator lights)
⑥	**DISP. CHK**	**RST**

⑦ Make sure that the **M** indicator goes out. (End of measurement)

If the **SAMPLE NUMBER** is set to a value less than that specified in Step ③ (for example, 10^0, 10^1 or 10^2) and if the switch is pressed, this message may be output.

(2) If the following message is displayed when the **TR5830** is operating, stop using it and contact the nearest service representative for technical support. The addresses and phone numbers of dealers and representatives are listed at the end of this manual.



2.5 Frequency Measurement

This section explains how to measure signal frequency. Figure 2-12 shows the operation keys and indicators which are used in this sequence.

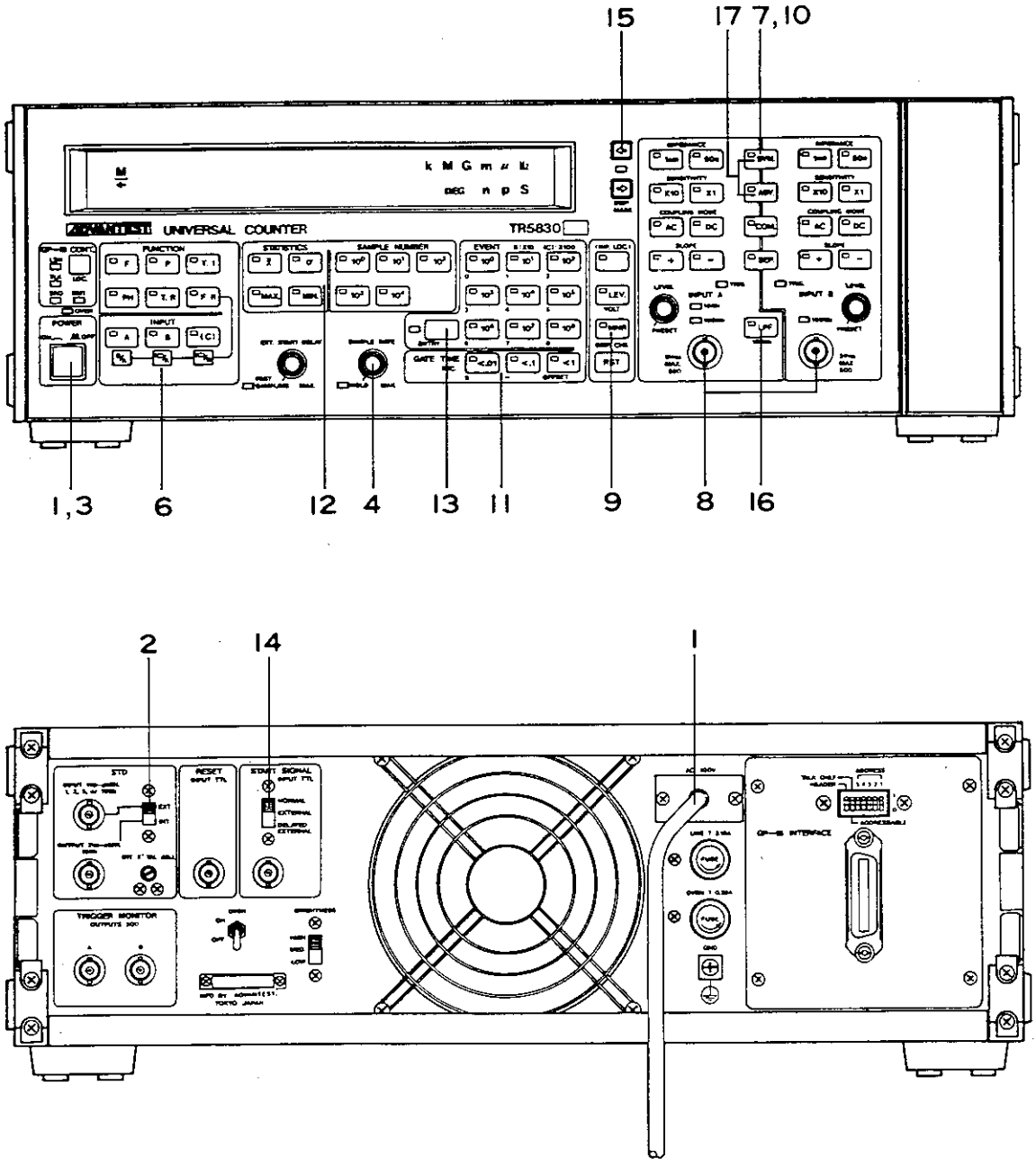


Figure 2-12 Operation points for frequency measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and that the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel to "**INT.**".
However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**". Connect the external reference signal cable to the **INPUT** connector.

(3) Press the **POWER** switch to turn it **ON.**

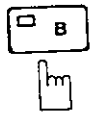
(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

(5) Check for normal operation in initial status. See Section 2.4.1.

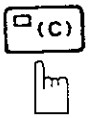
(6) Select the **INPUT** port according to the signal under test.

(a) If the signal under test is 10 MHz or less, press the **INPUT** 

button and the LED will light.

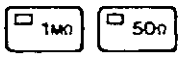
(b) If the signal under test is 100 MHz or less, press the **INPUT** 

button and the LED will light.

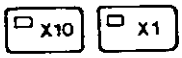
(c) If the signal under test is 1000 MHz or less, press the **INPUT** 

button (optional) and the LED will light.

(7) Select the input conditions according to the signal under test.

(a) **IMPEDANCE** 

The **1-M**ohm mode can be selected for normal measurement. However, when measuring quick rise pulses or radio frequencies or when the impedance of the measuring systems must match, it must be set to **50**-ohm mode. If the highest input impedance is used for measurement, the **1-M**ohm mode must be selected and an oscilloscope probe used.

(b) **SENSITIVITY** 

The following shows the breakdown input voltages of **INPUT A** and **INPUT B.** The voltages must never exceed this limit.

When the 

SENSITIVITY key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
25 Vrms for 100 kHz to 100 MHz

The breakdown input voltage of **INPUT C** is:
5 Vrms for both **SENSITIVITY** ×**10** and ×**1**.

(8) Enter the signal under test into the input connector selected in Step 6.

(9) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(10) Set the **SENSITIVITY** and **COUPLING MODE** according to the DC level or amplitude of the signal under test, and adjust the **LEVEL** control to light the "**TRIG.**" indicator. See Section 2.14.

(11) Set the desired **GATE TIME** or **EVENT** when necessary.
Note: Since **INPUT B** has a 1/10 pre-scaler, the actual **EVENT** count is equal to the specified **EVENT** value multiplied by 10.
Also, since **INPUT C** (optional) has a 1/100 pre-scaler, and the actual **EVENT** count is equal to the specified **EVENT** value multiplied by 100.

(12) Set the desired **SAMPLE NUMBER** and **STATISTICS** when necessary. For the **STATISTICS** (statistics calculation function), see Section 2.11.

(13) Select the **ENTRY** mode when necessary.
For addition and subtraction in **ENTRY** mode, see Section 2.12.

(14) Use the "**EXT. START**" function when necessary. For the external startup function, see Section 2.13.

(15) Mask the unnecessary digits by selecting "**DISP. MASK**" when necessary.

(16) Use the **LPF** (low-pass filter) when necessary.

(17) Set the "**SYN.**" or "**ASY**" when necessary.
In the "**SYN.**" mode, the second signal triggers measurement for INPUT A. For INPUT B, the 20th or later signal triggers measurement, and for INPUT C, the 200th or later signal triggers measurement. While in the "**ASY**" mode, the first, 10th and 100th signals trigger measurement, respectively.

2.6 Signal Period Measurement

This section explains how to measure the signal period. Figure 2-13 shows the operation keys and indicators which are used in this sequence.

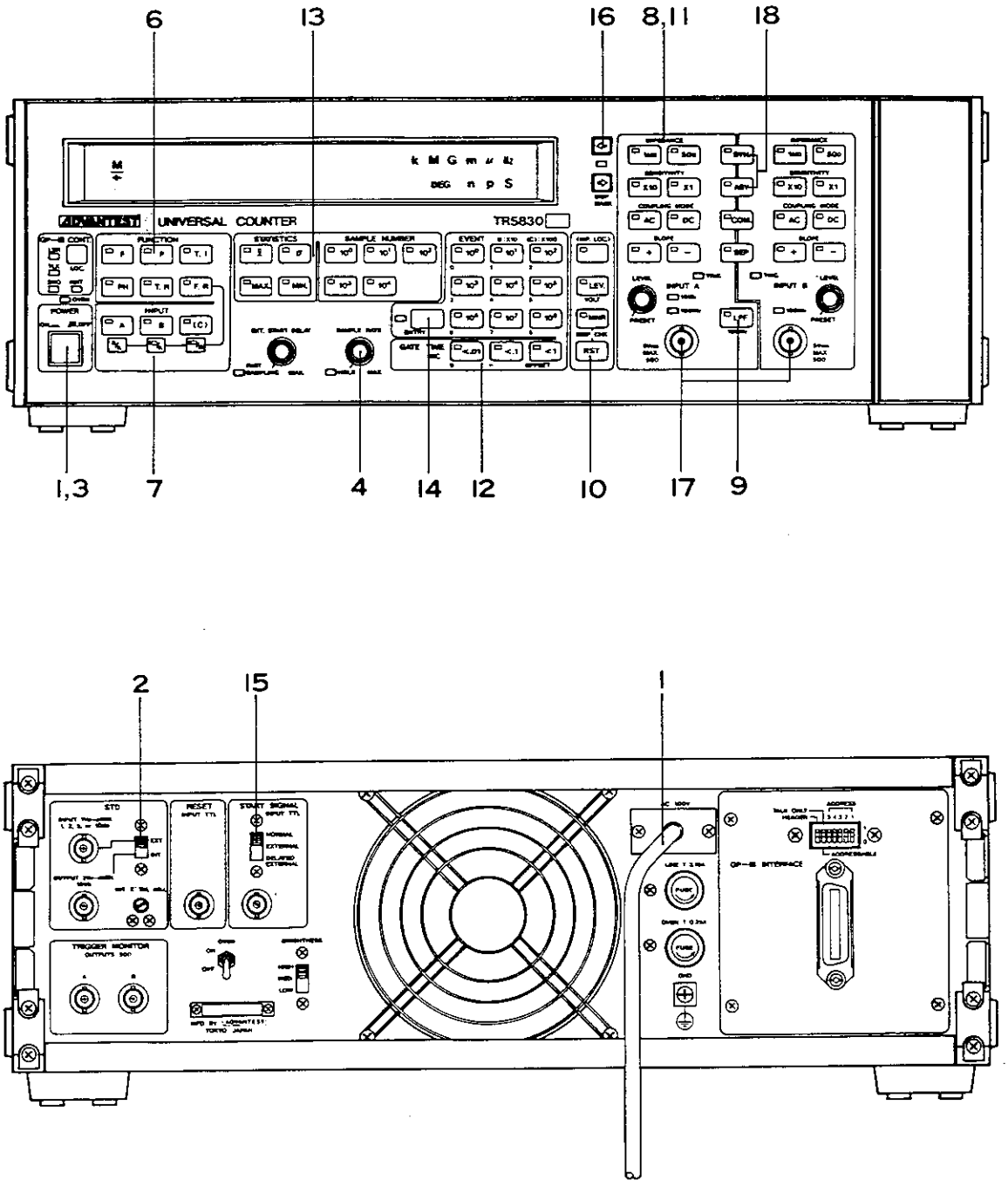


Figure 2-13 Operation points for period measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel to the "**INT.**". However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**". Connect the external reference signal cable to the **INPUT** connector.

(3) Press the **POWER** switch to turn it **ON**.

(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

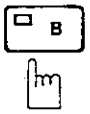
(5) Check normal operation in initial status. See Section 2.4.1.

(6) Set the "**P**" **FUNCTION** to check operation in check mode. See Section 2.4.2 for checkout.

(7) Select the **INPUT** port according to the signal under test.

(a) If the signal under test is 100 nsec or more, press the **INPUT** 

button and the LED will light.

(b) If the signal under test is 10 nsec or more, press the **INPUT** 

button and its LED will light.

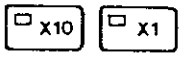
(c) If the signal under test is 1 nsec or more, press the **INPUT** 

button (optional) and the LED will light.

(8) Select the input conditions according to the signal under test.

(a) **IMPEDANCE** 

The **1-M**ohm mode can be selected for normal measurement. However, when measuring quick rise pulses or radio frequencies or when the impedance of the measuring systems must match, or when noise may be inserted into the cable, it must be set to **50**-ohm mode. If the highest input impedance is used for measurement, the **1-M**ohm mode must be selected and an oscilloscope probe used.

(b) **SENSITIVITY** 

The following shows the breakdown input voltages of **INPUT A** and **INPUT B**. The voltages must never exceed this limit.

When the 

SENSITIVITY key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
25 Vrms for 100 kHz to 100 MHz

The breakdown input voltage of **INPUT C** is:
5 Vrms for both **SENSITIVITY** ×**10** and ×**1**.

(9) Enter the signal under test into the input connector selected in Step 7.

(10) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(11) Set the **SENSITIVITY** and **COUPLING MODE** according to the DC level or amplitude of the signal under test, and adjust the **LEVEL** control to light the "**TRIG.**" indicator. See Section 2.14.

(12) Set the desired **GATE TIME** or **EVENT** when necessary.
Note: Since **INPUT B** has a 1/10 pre-scaler, the actual **EVENT** count is equal to the specified **EVENT** value multiplied by 10.
Also, since **INPUT C** (optional) has a 1/100 pre-scaler, the actual EVENT count is equal to the specified **EVENT** value multiplied by 100.

(13) Set the desired **SAMPLE NUMBER** and **STATISTICS** when necessary.
For the **STATISTICS** (statistics calculation function), see Section 2.11.

(14) Select the **ENTRY** mode when necessary.
For addition and subtraction in **ENTRY** mode, see Section 2.12.

(15) Use the "**EXT. START**" function when necessary. For the external startup function, see Section 2.13.

(16) Mask the unnecessary digits by selecting "**DISP. MASK**" when necessary.

(17) Use the **LPF** (low-pass filter) when necessary.

(18) Set the "**SYN.**" or "**ASY**" when necessary.
In the "SYN." mode, the second signal triggers measurement for INPUT A. For INPUT B, the 20th or later signal triggers measurement, and for INPUT C, the 200th or later signal triggers measurement. While in the "ASY" mode, the first, 10th and 100th signals trigger measurement, respectively.

2.7 Time Interval Measurement

This section explains how to measure the signal time interval.
Figure 2-14 shows the operation keys and indicators which are used in this sequence.

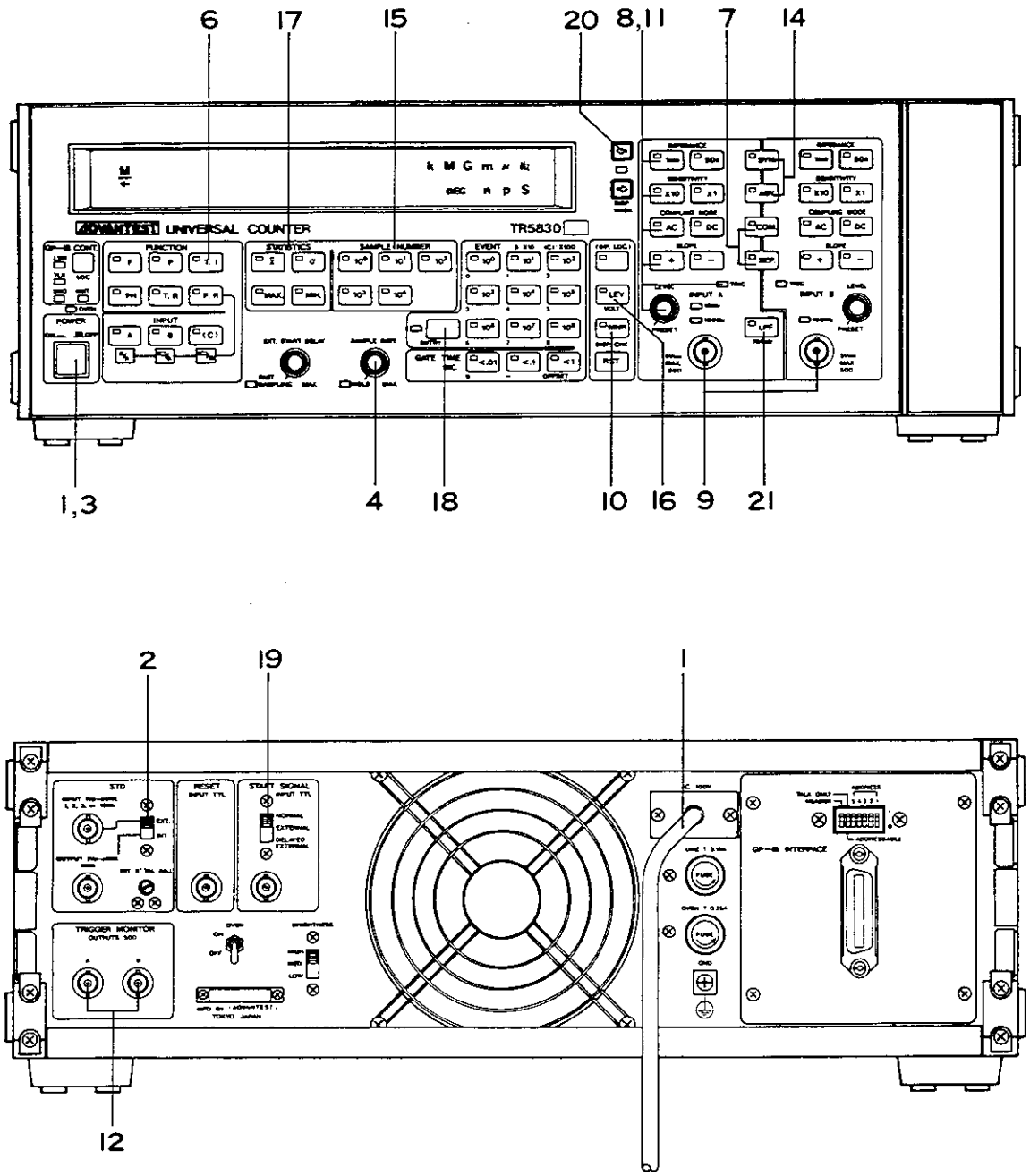


Figure 2-14 Operation points for time interval measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and that the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel to "**INT.**".
However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**". Connect the external reference signal cable to the **INPUT** connector.

(3) Press the **POWER** switch to turn it **ON**.

(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

(5) Check normal operation in initial status. See Section 2.4.1.

(6) Set the "**T.I.**" **FUNCTION** and check operation in check mode.
See Section 2.4.2 for checkout.

(7) Press 

when measuring a single signal according to the signal under test, and the LED will light. Press 

when measuring dual signals, and the LED will light.

The available input condition LED lights according to the above key setup.

At **INPUT A**	**IMPEDANCE** **SENSITIVITY** **COUPLING MODE**	Common to INPUT A and INPUT B
	SLOPE	
	LEVEL	
At **INPUT B**	**SLOPE**	
	LEVEL	

At **INPUT A**	**IMPEDANCE**
	SENSITIVITY
	COUPLING MODE
	SLOPE
	LEVEL
At **INPUT B**	**IMPEDANCE**
	SENSITIVITY
	COUPLING MODE
	SLOPE
	LEVEL

(8) Select the input conditions according to the signal under test.

(a) Set either [1MΩ] or [50Ω] **IMPEDANCE**.

(b) Set either [X10] or [X1] **SENSITIVITY**.

The following shows the breakdown input voltages of **INPUT A** and **INPUT B**. The voltages must never exceed this limit.

When the [X1] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
25 Vrms for 100 kHz to 100 MHz

(c) For the **SLOPE**, specify the rise (positive direction) or fall (negative direction) of the signal under test waveforms that trigger time period measurement.

(9) Enter the signal under test into the input connector.

(10) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(11) Set the **SENSITIVITY** and **COUPLING MODE** according to the DC level or amplitude of the signal under test, and adjust the **LEVEL** control to light the "**TRIG.**" indicator. See Section 2.14.

(12) When the "**TRIG.**" indicator lights, the trigger monitor signals are output from the **TRIGGER MONITOR** output connector on the rear panel.
The trigger point appears as the positive slope edge of the monitor output.
For **INPUT A**: The trigger monitor output at output connector **A** on the rear panel
For **INPUT B**: The trigger monitor output at output connector **B** on the rear panel
This output has a signal amplitude of approximately -0.4 Vo-p and is terminated with 50-ohm resistance.

(13) Make sure that the counter operates normally.

(14) Set the "**SYN.**" or "**ASY**" when necessary.
When [ASY.] is pressed, a time period separated by 10 nsec or more can be measured.

It is usually used in the "SEP." mode.
When [SYN.] is pressed, the positive and negative time period can be measured.

It is usually used in the "COM." modes.
During measurement, the time period varies depending on the signal pulse width, **SLOPE** +/-, **ASY/SYN**. and **COM./SEP**. setup combination used. For details, see Figure 3-4 of Section 3.3.2.

(15) Set the **SAMPLE NUMBER** when necessary.
10^0: Single pulse time period measurement
10^1 to **10^4**: Average time period measurement

(16) Use the "**LEV.**" when necessary. For the "**LEV.**" checking procedure, see Step 7 of Section 2.4.2.

(17) Set the desired **STATISTICS** when necessary. For the statistics calculation function, see Section 2.11.

(18) Select the **ENTRY** mode when necessary.
For addition and subtraction in **ENTRY** mode, see Section 2.12.

(19) Use the "**EXT. START**" function when necessary. For the external startup function, see Section 2.13.

(20) Mask the unnecessary digits by selecting "**DISP. MASK**" when necessary.

(21) Use the **LPF** (low-pass filter) when necessary. However, it is only effective when "**COM.**" is set. If "**SEP.**" is set, the **LPF** is used at **INPUT A** but the filter is not used at **INPUT B**.

2.8 Frequency Ratio Measurement

This section explains how to measure the signal frequency ratio.
Figure 2-15 shows the operation keys and indicators which are used in this sequence.

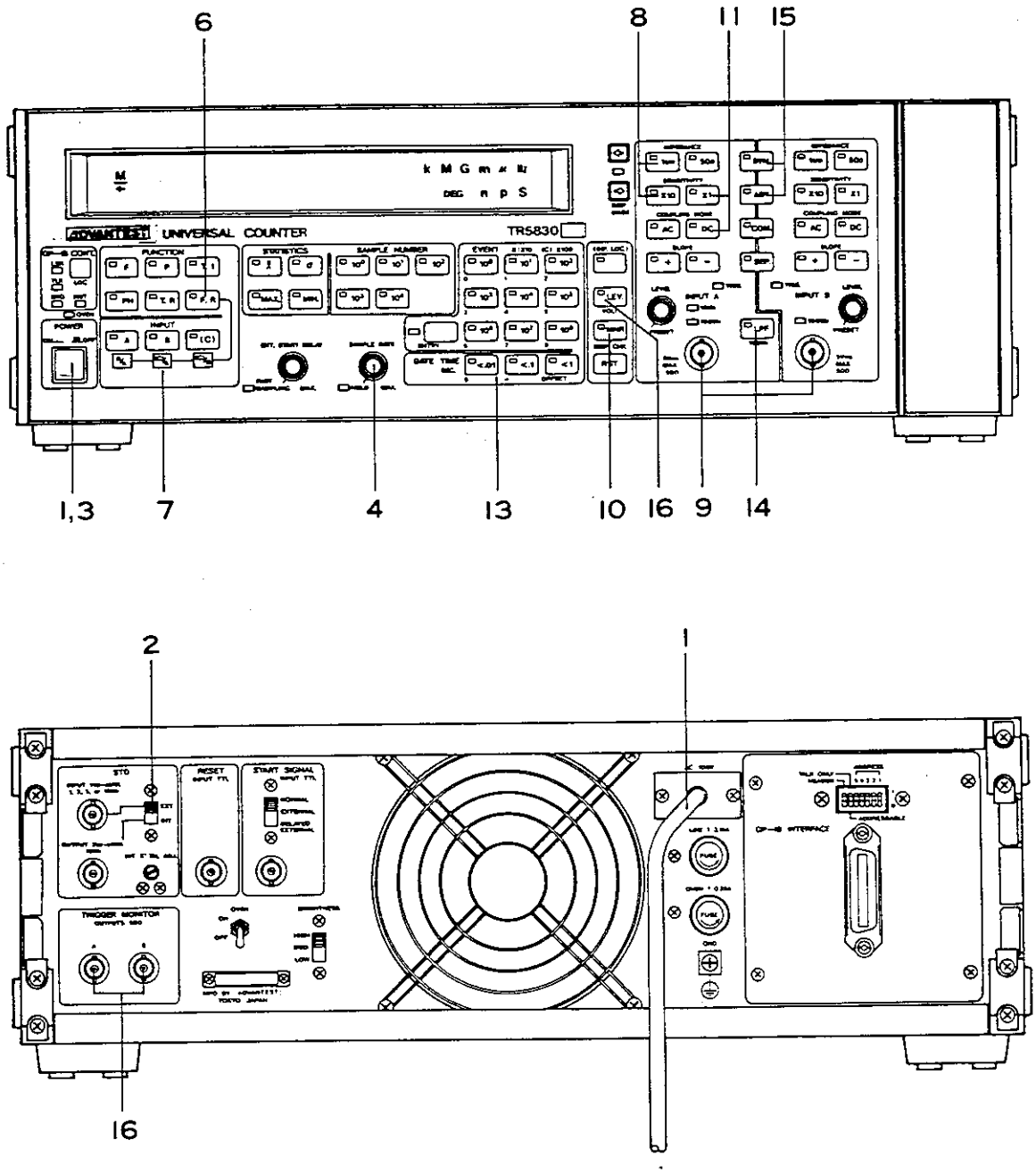


Figure 2-15 Operation points for frequency ratio measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and that the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel to "**INT.**".
However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**" Connect the external reference signal cable to the **INPUT** connector.

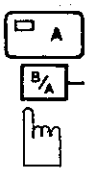
(3) Press the **POWER** switch to turn it **ON**.

(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

(5) Check normal operation in initial status. See Section 2.4.1.

(6) Set the "**F.R.**" **FUNCTION** and check operation in check mode. See Step (4) of Section 2.4.2 for checkout.

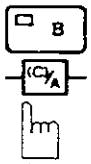
(7) Select the **INPUT** according to the measurement mode.

(a) **B/A** measurement 

The indicators for **INPUT A 10M**Hz and **INPUT B 100M**Hz light.

Signal under test at **INPUT A**: **10 M**Hz or less
Signal under test at **INPUT B**: **100 M**Hz or less

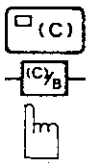
(b) **(C)/A** measurement (available if the option-21 C input unit is mounted)



The indicators for **INPUT A 10M**Hz and **INPUT C 1000M**Hz light.

Signal under test at **INPUT A**: 10 MHz or less
Signal under test at **INPUT C**: 1000 MHz or less

(c) **(C)/B** measurement (available if the option-21 C input unit is mounted)



The indicators for **INPUT B 100M**Hz and **INPUT C 1000M**Hz light.

Signal under test at **INPUT B**: **100 M**Hz or less
Signal under test at **INPUT C**: **1000 M**Hz or less

(8) Select the input conditions according to the signal under test.

(a) **IMPEDANCE** [1MΩ] [50Ω]

The **1-M**ohm mode can be selected for normal measurement. However, when measuring quick rise pulses or radio frequencies measured and the impedance of the measuring systems must or when noise may be inserted into the cable, it must be set to **50**-ohm mode. If the highest input impedance is used for measurement, the **1-M**ohm mode must be selected and an oscilloscope probe used.

The input impedance of **INPUT C** is fixed at **50** ohms.

(b) **SENSITIVITY** [X10] [X1]

The following shows the breakdown input voltages of **INPUT A** and **INPUT B**. The voltages must never exceed this limit.

When the [X1] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:

5 Vrms

If the **IMPEDANCE** is **1M** ohms:

100 Vrms for DC to 100 kHz

5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:

5 Vrms

If the **IMPEDANCE** is **1M** ohms:

100 Vrms for DC to 100 kHz

25 Vrms for 100 kHz to 100 MHz

The breakdown input voltage of **INPUT C** is:

5 Vrms for both **SENSITIVITY** ×**10** and ×**1**.

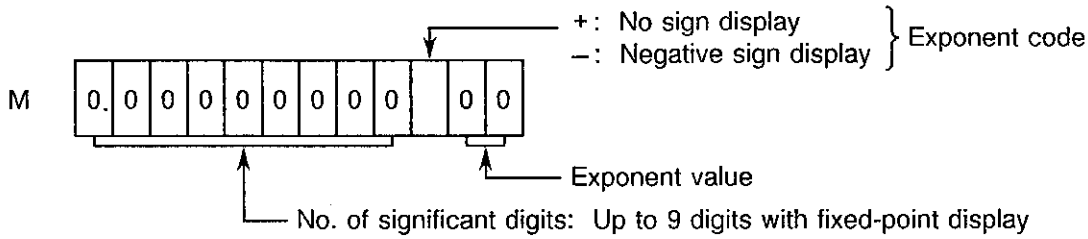
(9) Enter the signals under test into their input connectors.

(10) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(11) Set the **SENSITIVITY** and **COUPLING MODE** according to the DC level or amplitude of the signal under test for **INPUT A** and **INPUT B**. Then, adjust the **LEVEL** control to light the "**TRIG.**" indicator. See Section 2.14.

For **INPUT C**, set the **SENSITIVITY** and make sure that the "**OPER.**" indicator lights. See Chapter 4.

(12) The exponent of base 10 is displayed.



(13) Set the **GATE TIME** and **EVENT** when necessary.
If the **"F.R." FUNCTION** is set, the counter measures each input signal of the denominator and numerator separately, and calculates the ratio through internal calculation.
Both the denominator and numerator must be measured with the same **GATE TIME** and **EVENT**.

Note: Since **INPUT B** has a 1/10 pre-scaler, the actual **EVENT** count is equal to the specified **EVENT** value multiplied by 10.
Also, since **INPUT C** (optional) has a 1/100 pre-scaler, the actual **EVENT** count is equal to the specified **EVENT** value multiplied by 100.

(14) Use the **LPF** (low-pass filter) for **INPUT A** only when necessary.

(15) Set the **"SYN."** or **"ASY"** when necessary.
In "SYN." mode, the second signal triggers measurement for INPUT A. For INPUT B, the 20th or later signal triggers measurement, and for INPUT C, the 200th or later signal triggers measurement. While in "ASY" mode, the first, 10th, and 100th signals trigger measurement, respectively.

(16) Set the **"LEV."** when necessary to monitor the trigger level on the oscilloscope.

2.9 Phase Measurement

This section explains how to measure the signal phase.
Figure 2-16 shows the operation keys and indicators which are used in this sequence.

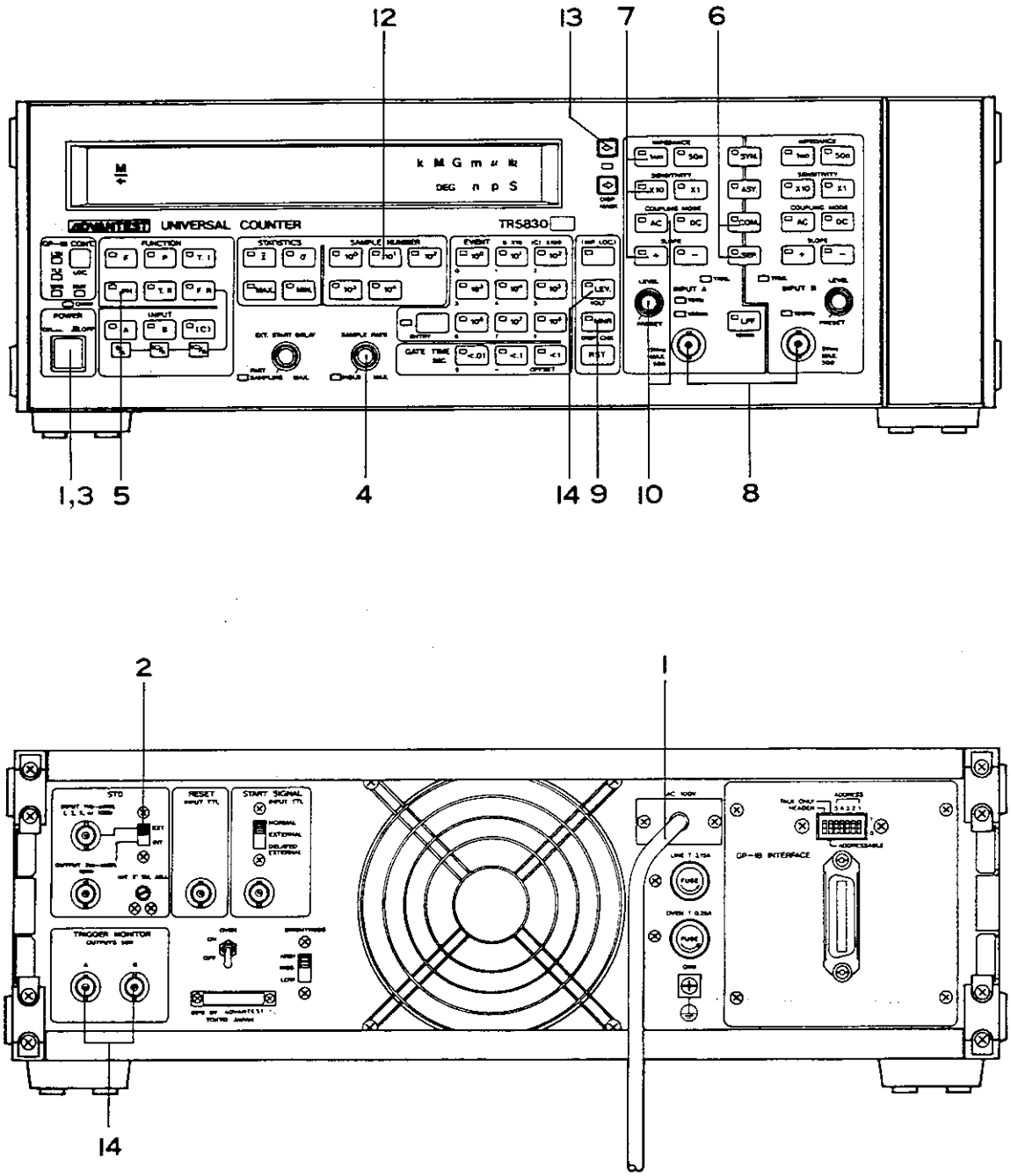


Figure 2-16 Operation points for signal phase measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and that the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel to the "**INT.**". However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**". Connect the external reference signal cable to the **INPUT** connector.

(3) Press the **POWER** switch to turn it **ON**.

(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

(5) Set the "**PH**" **FUNCTION** and make sure that the corresponding LED lights.

(6) Press "**SEP.**" of the "**COM./SEP.**" switch.

INPUT A side	**INPUT B** side
IMPEDANCE	**IMPEDANCE**
SENSITIVITY	**SENSITIVITY**
COUPLING MODE	**COUPLING MODE**
SLOPE	**SLOPE**
LEVEL	**LEVEL**

Make sure that the LEDs of the available switches listed above light.

(7) Select the input conditions according to the signal under test.

(a) Set either [1MΩ] or [50Ω] **IMPEDANCE.**

(b) Set either [X10] or [X1] **SENSITIVITY.**
The following shows the breakdown input voltages of **INPUT A** and **INPUT B**. The voltages must never exceed this limit.

When the [X1] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
25 Vrms for 100 kHz to 100 MHz

(c) Set the positive (+) or negative (-) **SLOPE**. The following provides the relationship between the slope setup and the signal phase.

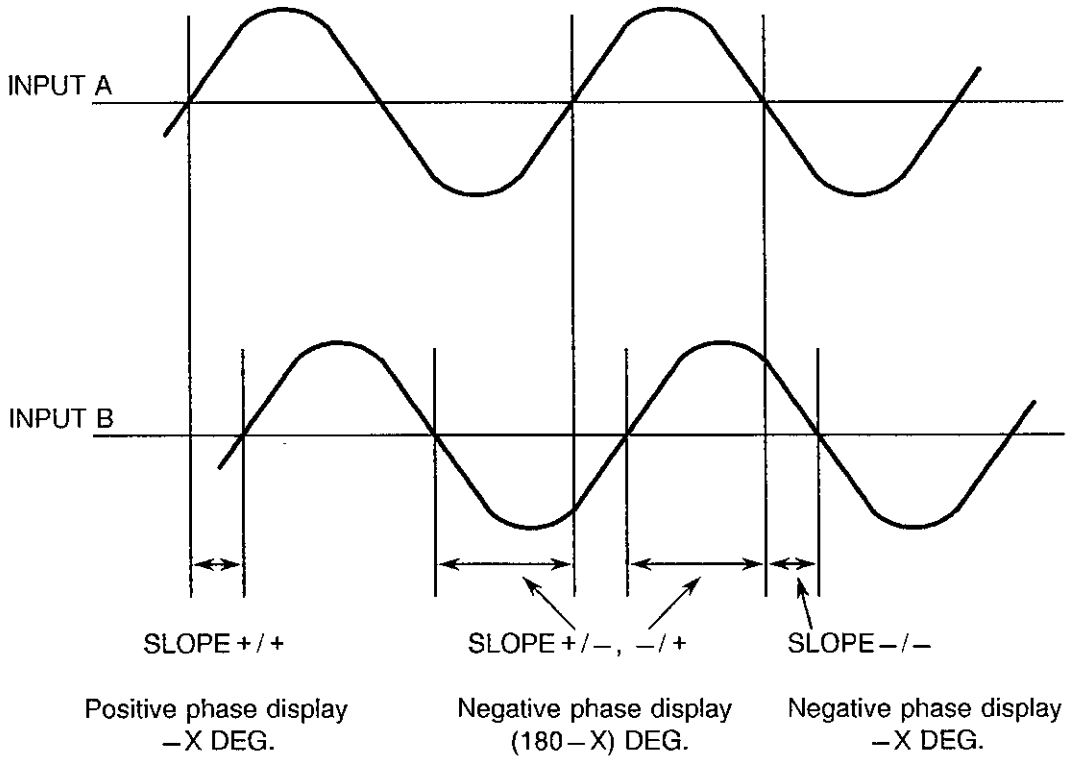


Figure 2-17 Relationship between slope setup and phases

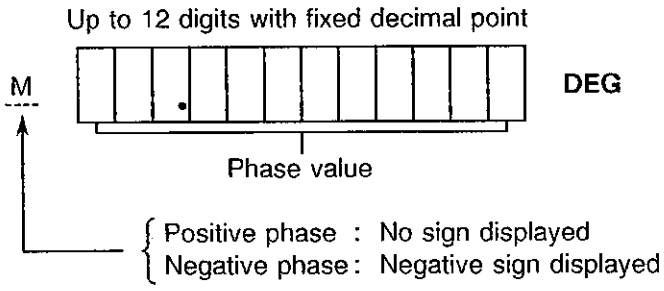
If the signal phase of **INPUT B** is delayed compared with that of **INPUT A** as show in Figure 2-17, then:
The negative phase is displayed when the same slope is set.
The positive phase is displayed when a different slope is set.
If the signal phase of **INPUT A** is delayed compared with that of **INPUT B**:
The positive phase is displayed when the same slope is set.
The negative phase is displayed when a different slope is set.

(8) Enter the signal under test into the input connector selected.

(9) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(10) As the signals under test are usually sine waves during phase measurement, the **COUPLING MODE** switch must be set to **AC** but the **LEVEL** control can be set to any position.
The **SENSITIVITY** and **COUPLING MODE** must be set when necessary, and the **LEVEL** control adjusted to light the "**TRIG.**" indicator for measurement.

(11) Make sure that the counter operates normally.



(12) Set the **SAMPLE NUMBERs** 10^1 to 10^4 when necessary, and the average will be displayed. In this case, a single response time measuring cycle is required. If the other function is changed to "**PH**", the **SAMPLE NUMBER** setup is changed, or if the measuring frequency varies 10% or more, this response time is inserted and the single cycle of data immediately after it differs from the true value.
If the measuring frequency varies more than 10% continuously, the 10^0 **SAMPLE NUMBER** must be used. When the **PH** function is set, the counter measures the period and time interval twice, calculates the expression (Time interval/INPUT A cycle time) × 360 degrees, and displays the phase. If the "**TRIG.**" indicator of **INPUT A** or **INPUT B** remains lit and measurement does not start, press **RST**.

(13) Mask the unnecessary digits by selecting "**DISP. MASK**" when necessary.

(14) Set "**LEV.**" when necessary to monitor the trigger level on the oscilloscope.

2.10 Time Ratio Measurement

This section explains how to measure the time ratio.
Figure 2-18 shows the operation keys and indicators which are used in this sequence.

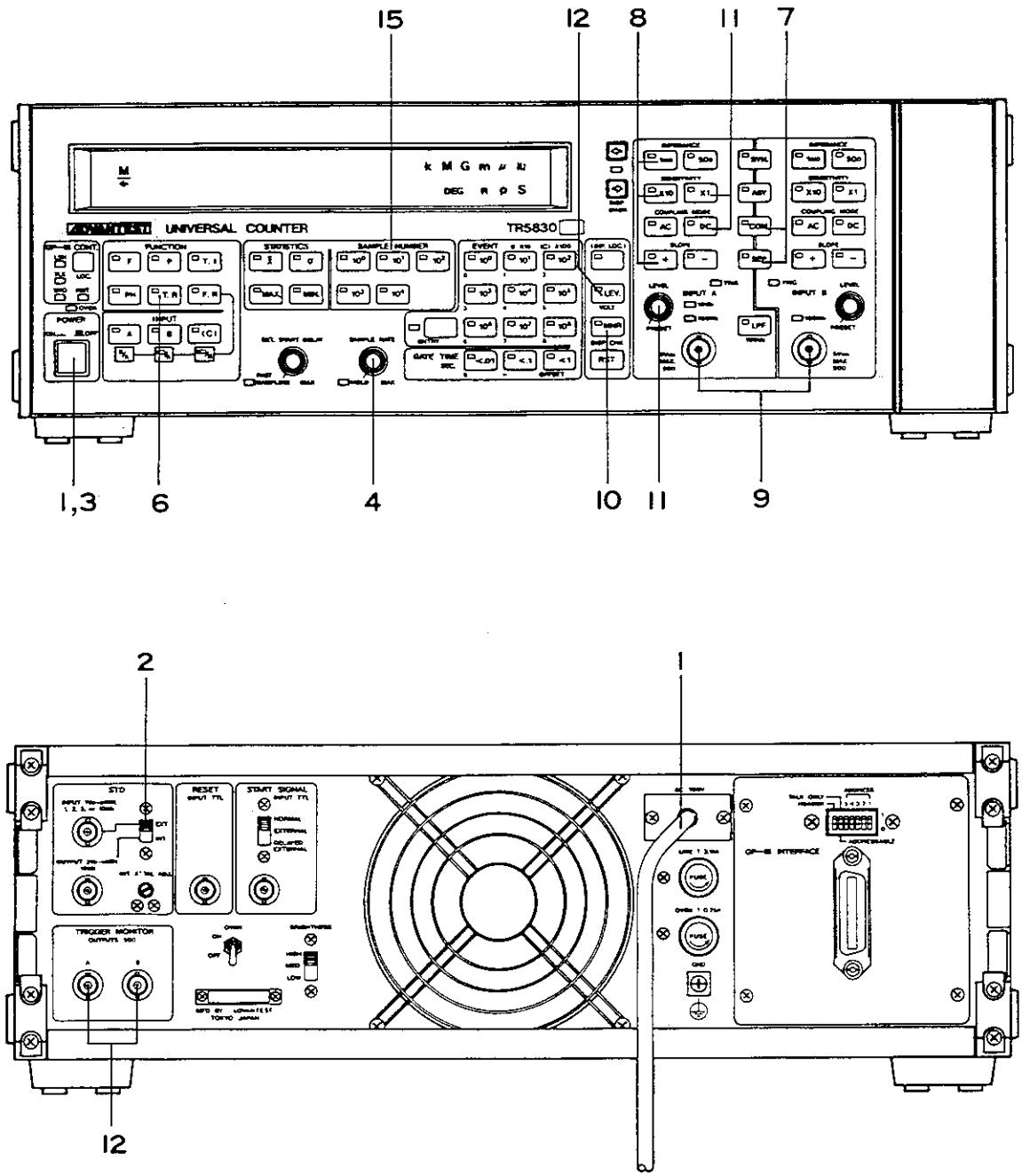


Figure 2-18 Operation points for time ratio measurement

(1) Make sure that the front panel **POWER** switch is turned **OFF** and that the AC power voltage is within the voltage range (the voltage printed on the nameplate ±10%). Plug the power cord into the wall socket.

(2) Set the "**STD.EXT./INT.**" selector on the rear panel the "**INT.**".
However, when the reference time signals are entered from a peripheral, the switch must be set to "**EXT.**". Connect the external reference signal cable to the **INPUT** connector.

(3) Press the **POWER** switch to turn it **ON**.

(4) Rotate the **SAMPLE RATE** control counterclockwise (CCW) to the point immediately before the **HOLD** switch position (for minimum sample rate setup).

(5) Check normal operation in initial status. See Section 2.4.1.

(6) Set the "**T.R.**" **FUNCTION** and check operation in check mode.
See Section 2.4.2 for checkout.

(7) Select "**COM.**" or "**SEP.**" mode as follows. Each mode allows measurement to be made twice.

Measures the time ratio using the time interval between the two signals under test and the period of INPUT A.

$$\frac{\text{Separate time interval}}{\text{Period of INPUT A}}$$

Measures the time ratio using the time interval of a single signal under test and the period.

$$\frac{\text{Common time interval}}{\text{Period of INPUT A}}$$ (for pulse duty factor measurement)

The following shows the input conditions for each setup.

INPUT A side	**INPUT B** side
IMPEDANCE	**IMPEDANCE**
SENSITIVITY	**SENSITIVITY**
COUPLING MODE	**COUPLING MODE**
SLOPE	**SLOPE**
LEVEL	**LEVEL**

INPUT A side		**INPUT B** side
IMPEDANCE	*	
SENSITIVITY		
COUPLING MODE		
SLOPE		**SLOPE**
LEVEL		**LEVEL**

* Common to **INPUT A** and **INPUT B**

Make sure that the LEDs of available switches light.

(8) Select the input conditions according to the signal under test.

(a) Set either [1MΩ] or [50Ω] **IMPEDANCE**.

(b) Set either [X10] or [X1] **SENSITIVITY**.

The following shows the breakdown input voltages of **INPUT A** and **INPUT B**. The voltages must never exceed this limit.

When the [X1] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
5 Vrms for 100 kHz to 100 MHz

When the [X10] **SENSITIVITY** key is pressed:

If the **IMPEDANCE** is **50** ohms:
5 Vrms

If the **IMPEDANCE** is **1M** ohms:
100 Vrms for DC to 100 kHz
25 Vrms for 100 kHz to 100 MHz

(c) For the relationship between the **SLOPE** setup and the time interval of the numerator, see Section 3.3.2.

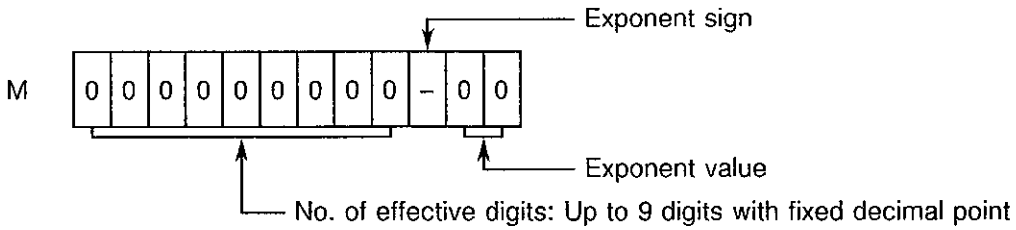
(9) Enter the signal under test into the input connector.

(10) Press [MNR] to release the self-check status. (Make sure that the LED goes out.)

(11) Set the **SENSITIVITY** and **COUPLING MODE** according to the DC level or amplitude of the signal under test for **INPUT A** and **INPUT B**. Then, adjust the **LEVEL** control to light the "**TRIG.**" indicator. See Section 2.14. If measurement does not start when both indicators light, press RST.

(12) Set "**LEV.**" when necessary to monitor the trigger point on the oscilloscope.

(13) The exponent of base 10 is displayed.



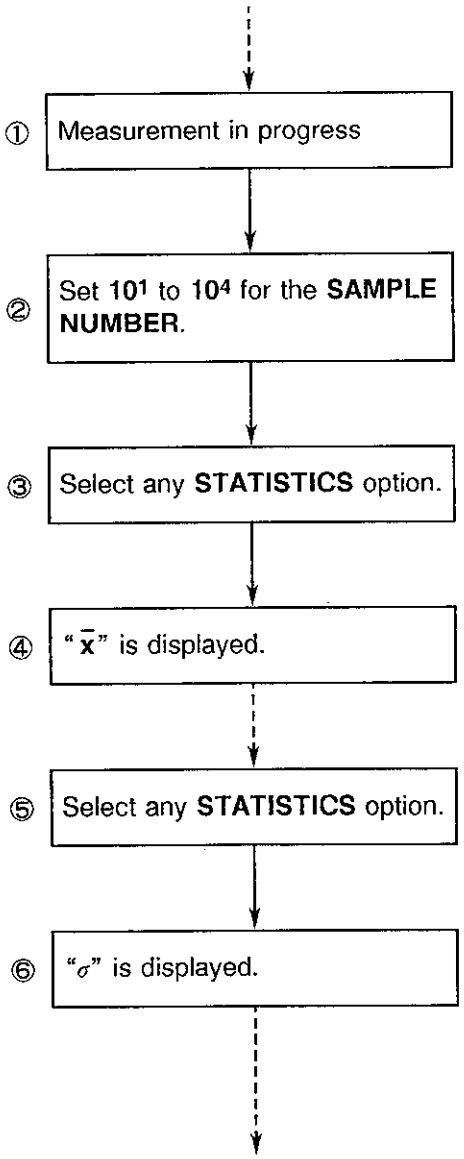
(14) Check for normal counter operation.

(15) Set the **SAMPLE NUMBERs** 10^1 to 10^4 when necessary, and the average will be displayed. In this case, a single response time measuring cycle is required.
If the other function is changed to "**T.R.**", the **SAMPLE NUMBER** setup is changed, or if the measuring frequency varies 10% or more, this response time is inserted and the single cycle of data immediately after it differs from the true value. If the measuring frequency varies more than 10% continuously, the 10^0 **SAMPLE NUMBER** must be used.

2.11 Operation of statistics calculation function

The statistics calculation function of the counter can be used in three modes: frequency measurement (**F**), period measurement (**P**), and time interval measurement (**T.I.**).
As explained in Step (8) of Section 2.4.2, statistics calculation is executed in two ways: calculation by setting the **SAMPLE RATE** to **HOLD** and using an option other than **HOLD**.

(a) If the **SAMPLE RATE** is set to an option other than **HOLD**

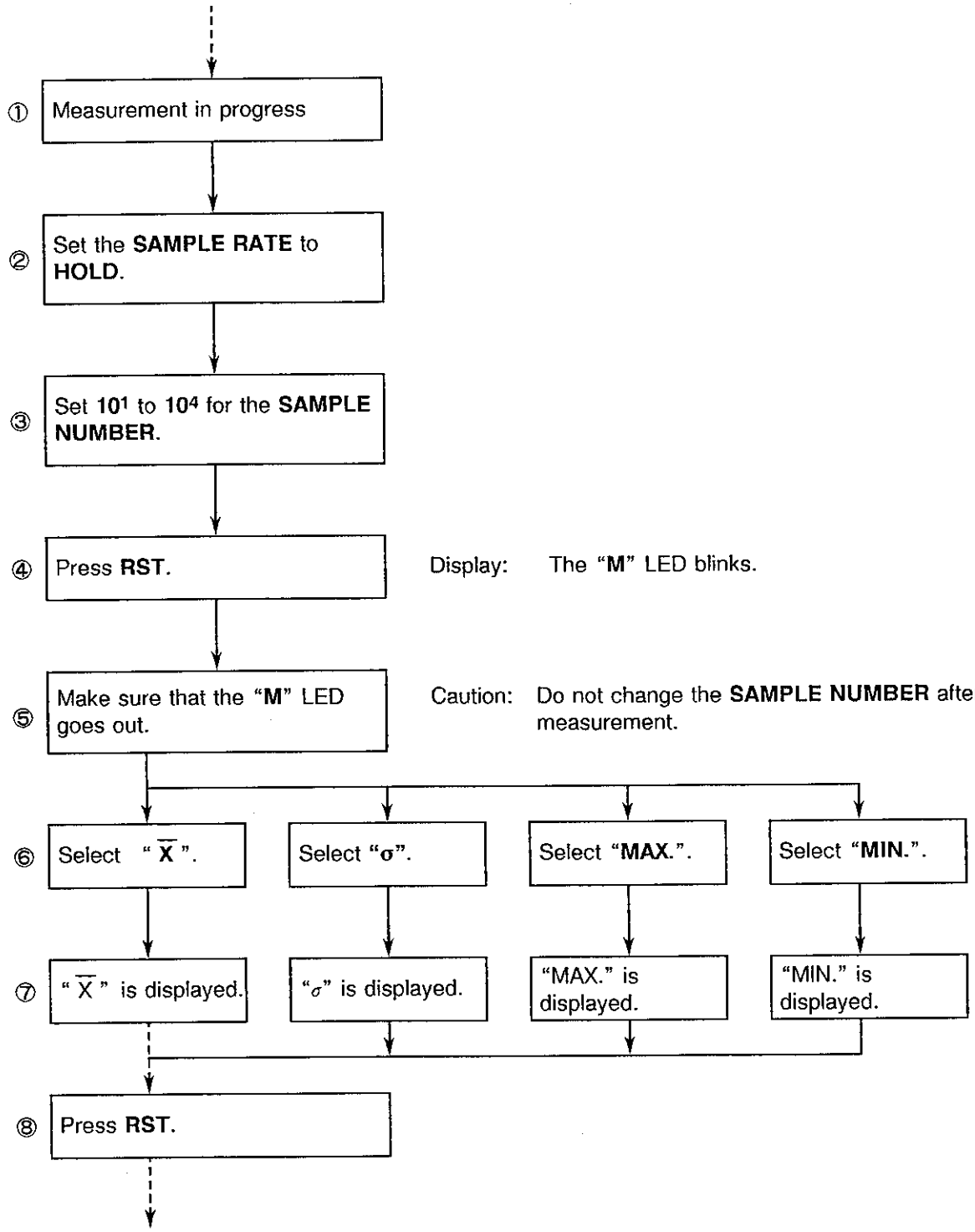


Note: If 10^0 is set, **STATISTICS** cannot be used. The LED remains off.

If "$\bar{X}$" is selected

If "σ" is selected

(b) If the **SAMPLE RATE** is set to the **HOLD** option



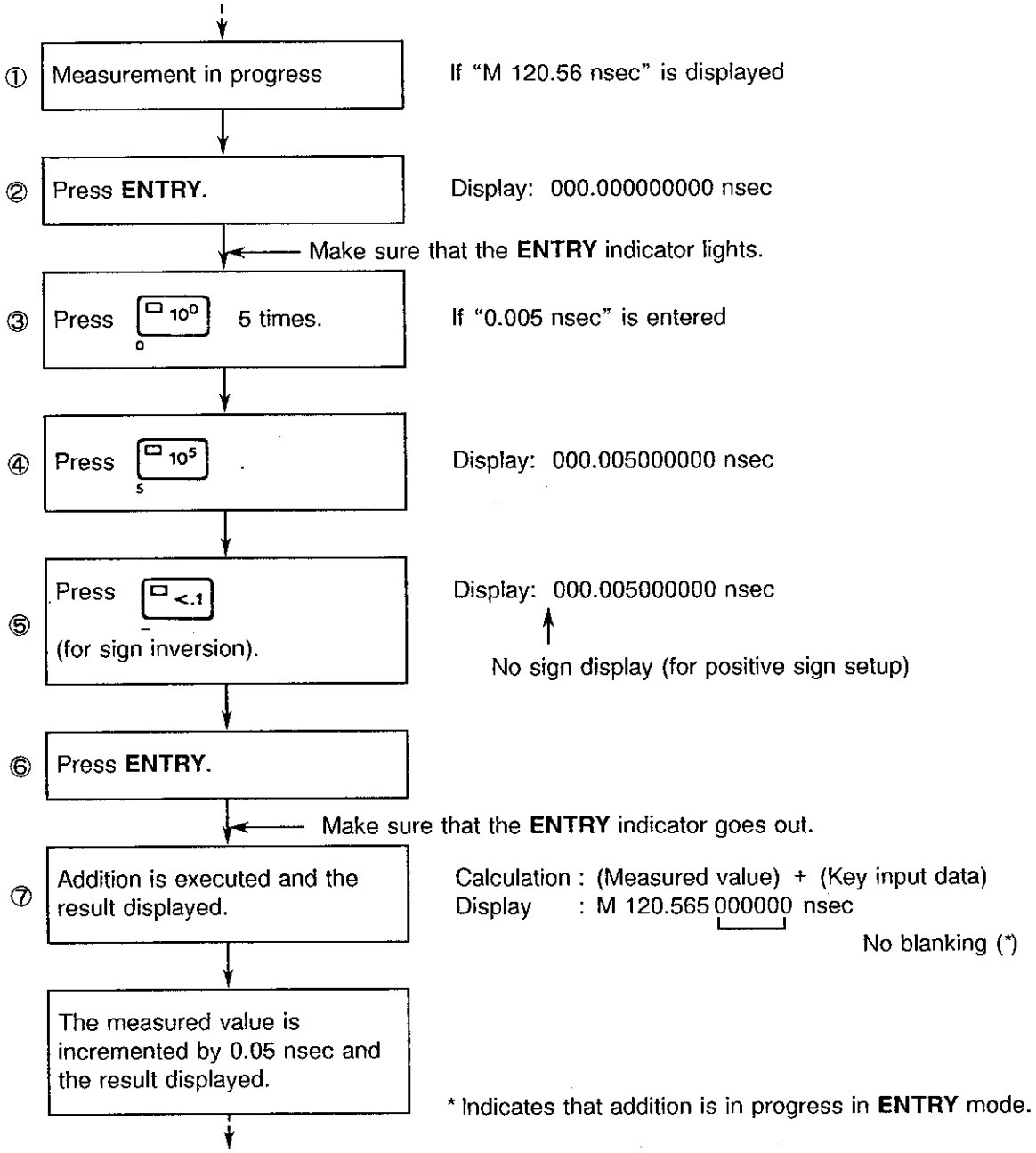
Since the "σ" value (standard deviation) may affect a wide range of measuring units, the normal unit or μHz, nHz, pHz, ks or Ms may be displayed.

2.12 Addition and subtraction function using **ENTRY**

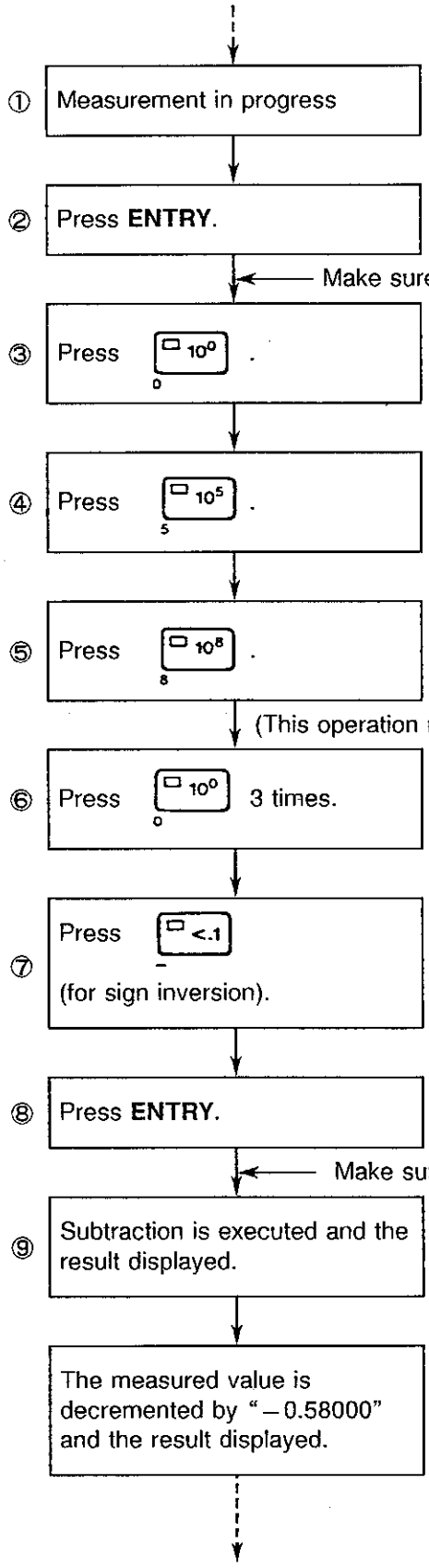
The addition and subtraction function of the counter can be used in three modes: frequency measurement (**F**), period measurement (**P**) and time interval measurement (**T.I.**).
The addition and subtraction function cannot be used in the check mode (during **MNR** setup).
This function can be used in the data preset mode by numeric key input (**0** to **9**) or in the offset mode by storage of measured data in memory.

2.12.1 Data preset mode using numeric keys

(a) Operation sequence example 1



(b) Operation sequence example 2



If "M 3.58 MHz" is displayed

Display: 0.00000000000 MHz
All 12 digits must be zeros.

If "0.58000 MHz" is entered
Display: 0.00000000000 MHz

Display: 0.50000000000 MHz

Display: 0.58000000000 MHz

Display: 0.58000000000 MHz

If subtraction is executed, for example:
Display: –0.58000000000 MHz

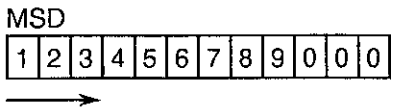
Calculation : (Measured value) - (Key input data)
Display : M 3.00000 000000 MHz
No blanking (*)

The **GATE TIME** is always less than "**<.01**" after **ENTRY** has been released.

* Indicates that subtraction is in progress in **ENTRY** mode.

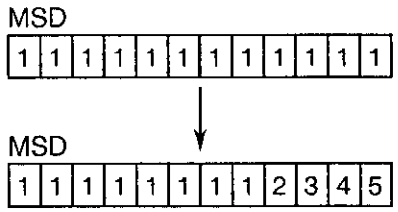
(c) Data input in **ENTRY** mode

① The numerical digits are entered sequentially from the MSD.



If digits **1** to **9** are entered sequentially from the numeric keypad.

② When numerical digits up to the LSD are entered, further digits are entered in the reverse sequence as in Step ① except when **ENTRY** mode is released.

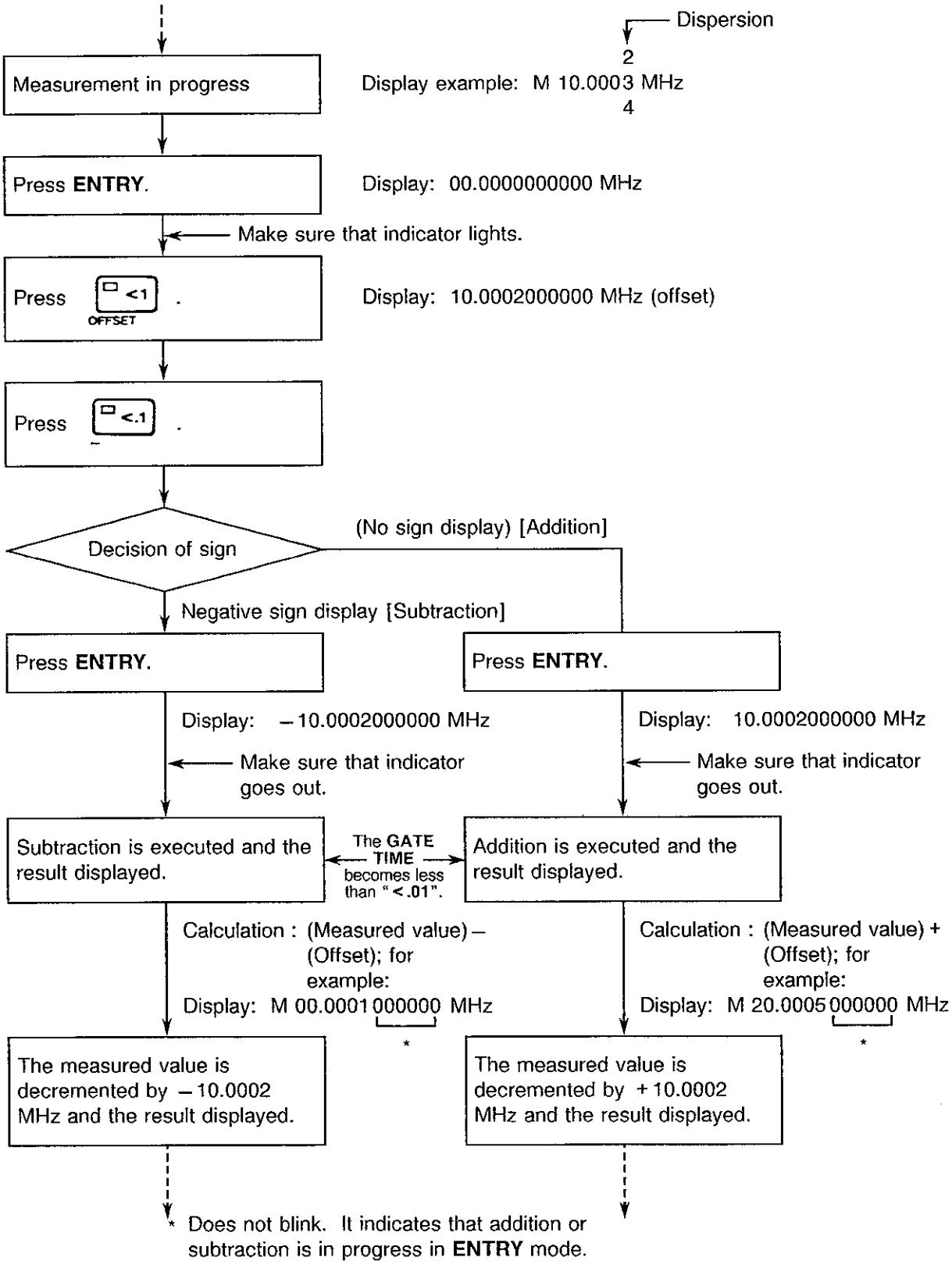


If 12 **1s** are entered, and if digits **2** to **5** are entered from the numeric keypad.

③ If a numeric key is held down more than 400 msec, this digit is repeated and entered.

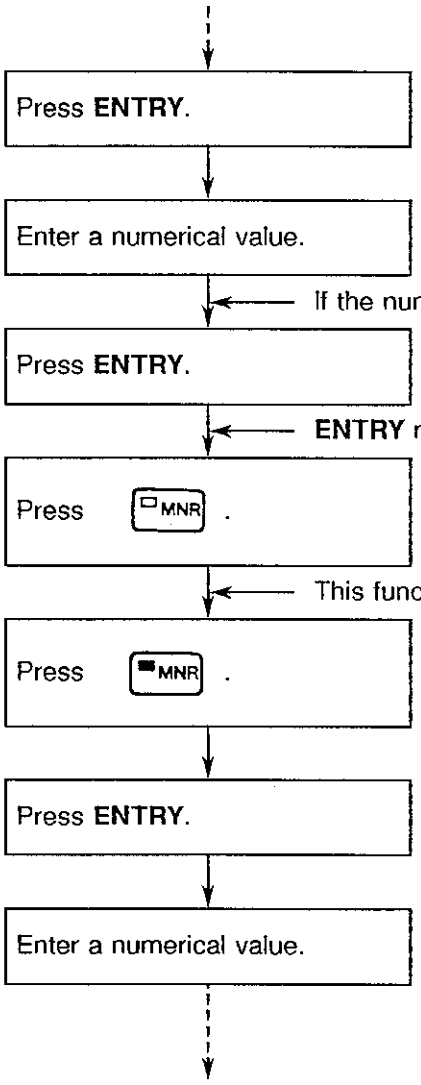
2.12.2 Operation in offset mode

(a) Operation sequence example



2.12.3 Numeric value change and **ENTRY** mode release operations

(a) When changing the numeric value



If the numerical value is changed

ENTRY mode is released. Make sure that the LED goes out.

Check mode is selected (and the memory is cleared).

This function checks the check mode operation.

Check mode is released. (If not, an E003 error message is displayed.)

Repeat from the beginning.

(b) When releasing the **ENTRY** mode

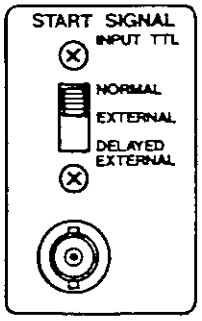
Once numeric data is stored in the internal memory by the numeric or **OFFSET** keys, it is not cleared except when the following operation is made.

To release the **ENTRY** mode, perform the following:

Make sure that the **ENTRY** indicator goes out.

2.13 External Startup Function

The counter starts when a start signal sent from a peripheral device enters the **START SIGNAL** connector on the counter rear panel. One of the following modes can be selected by slide switch.



NORMAL mode: Measurement is started by built-in timer signal (for normal operation).

EXTERNAL mode: Measurement is started by external control signal.

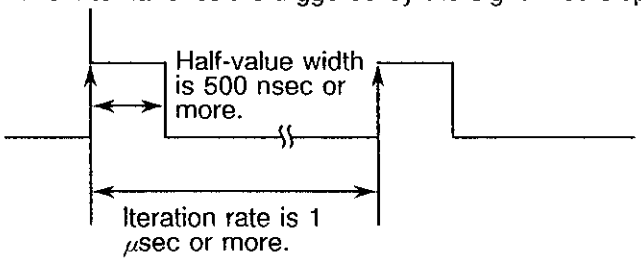
DELAYED EXTERNAL: Measurement start time can be delayed from 5 to 50 msec by the "**EXT. START DELAY**" control on the front panel. Measurement start timing by the external control signal is delayed.

The external startup function can be used in the frequency measurement (**F**), period measurement (**P**) or time interval measurement (**T.I.**) mode.

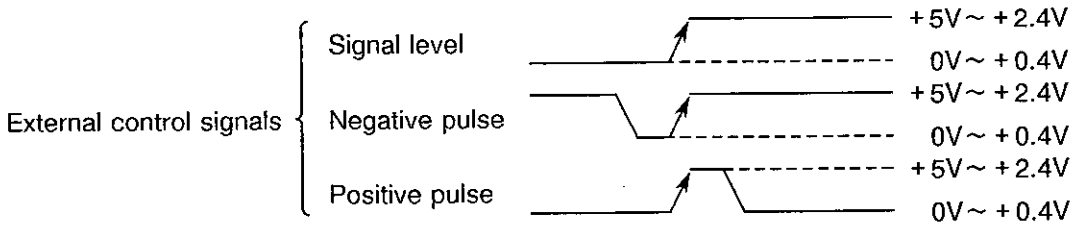
2.13.1 Interface of external control signals

(a) Specifications of external control signals

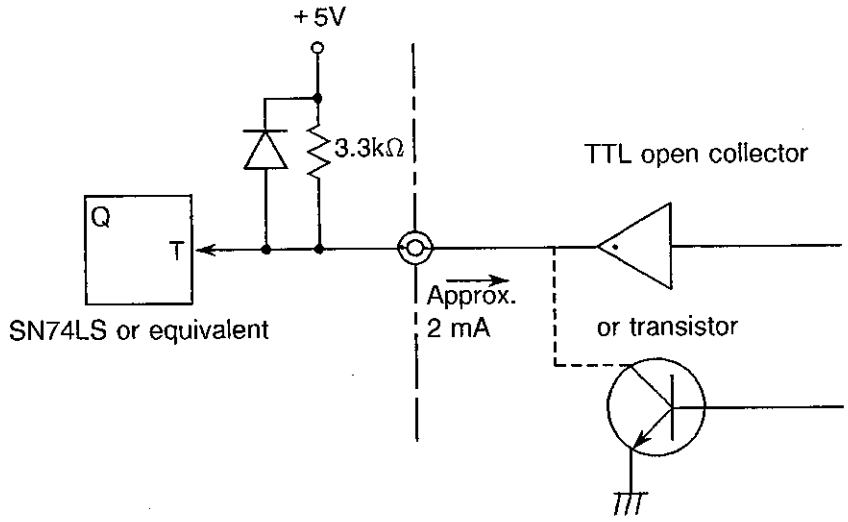
The internal circuit is triggered by the signal rise slope.



Signal level: TTL level
Logic high: +5 to +2.4 V
Logic low: 0 to +0.4 V
The edge of the rise slope causes a trigger.
Iteration rate: 1 microsecond or more
Half-value pulse width: 500 nsec or more



External control signal receiving circuit



When the external control signal is logical low, the current from the counter is approximately 2 mA. The system circuit must be designed to accept a larger current.

2.13.2 Operation and checkout in **EXTERNAL** mode

① Set the **START SIGNAL** selector on the rear panel to **EXTERNAL**.

② Make sure that the external control signals satisfy the specifications given in Section 2.13.1.

③ Plug the **INPUT A** connector cable into the **STD OUTPUT** connector on the rear panel. Set the front panel parameter switches as follows.

FUNCTION	**F**
SAMPLE RATE	Any position other than **HOLD**
SAMPLE NUMBER	**10^0**
GATE TIME	**<.01**
INPUT	**A**
Input conditions	
IMPEDANCE	**50Ω**
SENSITIVITY	**×1**
COUPLING MODE	**AC**
SLOPE	**+**
	SYN.
LEVEL	**PRESET**

Also, make sure that the **MNR, ENTRY, LEV., LPF** and **DISP. MASK** switches have been released (and their LEDs are off).

④ Plug the external control signal cable into the **START SIGNAL** connector on the rear panel.

⑤ Check for normal counter operation. The display must be as follows:

M 9.999996 MHz

⟆

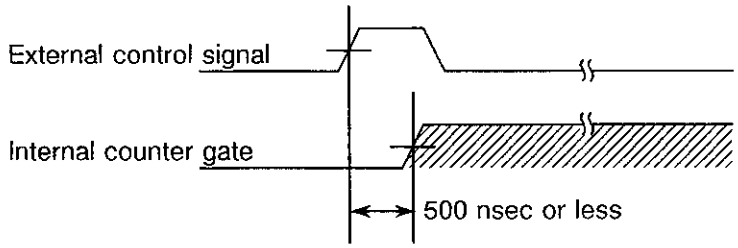
M 1.000004 MHz

⑥ Unplug the **INPUT A** signal cable from the **STD OUTPUT** connector on the rear panel, and plug the signal cable under test into the input connector on the front panel.

Further operation is the same as for frequency, period and time interval measurement.

Caution

The following shows the internal circuit timing in **EXTERNAL** mode.



2.13.3 Operation and checking in **DELAYED EXTERNAL** mode

① Set the **START SIGNAL** selector on the rear panel to **DELAYED-EXTERNAL**.

② Make sure that the external control signals satisfy the specifications given in Section 2.13.1.

③ Plug the **INPUT A** connector cable into the **STD OUTPUT** connector on the rear panel.

FUNCTION	**F**
SAMPLE RATE	Any position other than **HOLD**
SAMPLE NUMBER	10^0
GATE TIME	**<.01**
INPUT	**A**
Input conditions	
IMPEDANCE	**50Ω**
SENSITIVITY	**×1**
COUPLING MODE	**AC**
SLOPE	**+**
	SYN.
LEVEL	**PRESET**

Also, make sure that the **MNR, ENTRY, LEV., LPF** and **DISP. MASK** switches have been released (and their LEDs are off).

④ Plug the external control signal cable into the **START SIGNAL** connector on the rear panel.

⑤ Check for normal counter operation. The display must be as follows:

M 9.999996 MHz

⟆

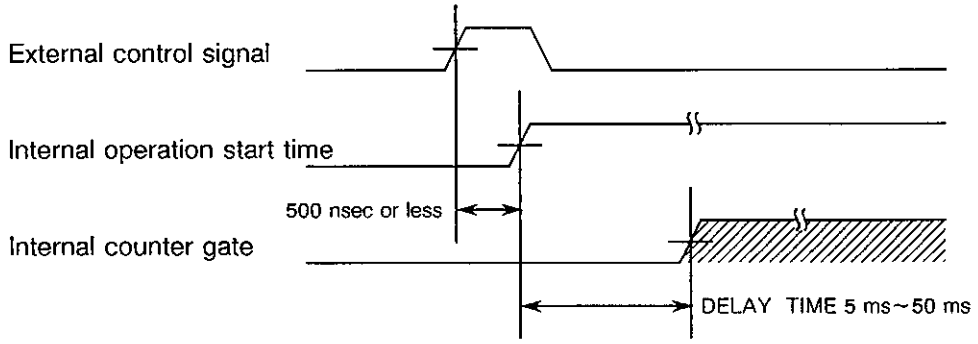
M 10.000004 MHz

⑥ Unplug the **INPUT A** cable from the **STD OUTPUT** connector on the rear panel, and plug the signal cable under test into the input connector on the front panel.
Further operation is the same as for frequency, period and time interval measurement.

⑦ Set **MNR** and "**T.I.**" when necessary, and adjust the "**EXT. START DELAY**" control to monitor the time delay.

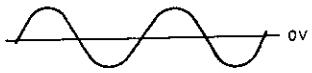
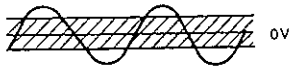
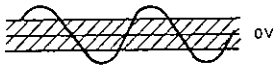
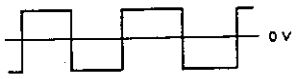
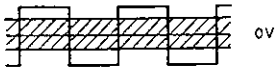
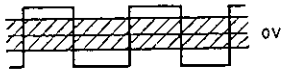
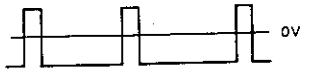
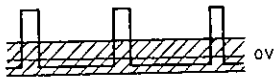
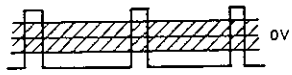
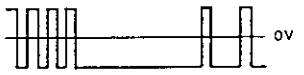
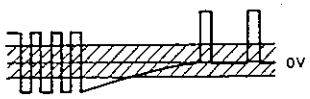
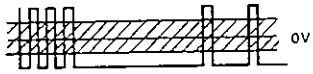
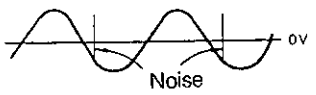
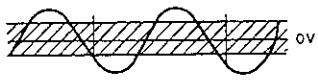
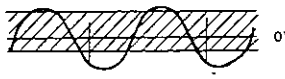
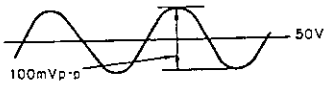
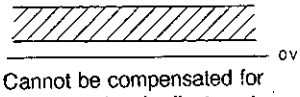
Caution

The following shows the internal circuit timing in **DELAYED EXTERNAL** mode.



2.14 Selection of Input Coupling Mode

Measurement may fail if the signal under test has certain waveforms or when excessive noise exists. Set the **AC/DC COUPLING MODE** parameters for **INPUT A** and **INPUT B** correctly (see Figure 2-19).

Input signal waveforms	AC coupling	DC coupling + Trigger level adjustment
Sine waves 	Can be measured. 	Can be measured. 
Pulse (Duty factor = 50%) 	Can be measured. 	Can be measured. 
Pulse (Duty factor ≠ 50%) 	Cannot be measured. 	Can be measured. 
Random pulse 	Cannot be measured. 	Can be measured. 
Signal having noise 	Cannot be measured.  The noise is also calculated.	Can be measured (if the trigger level is increased). 
If the DC components of the signal exceed the signal level: 	Can be measured. 	Cannot be measured.  Cannot be compensated for by trigger level adjustment.

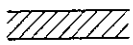
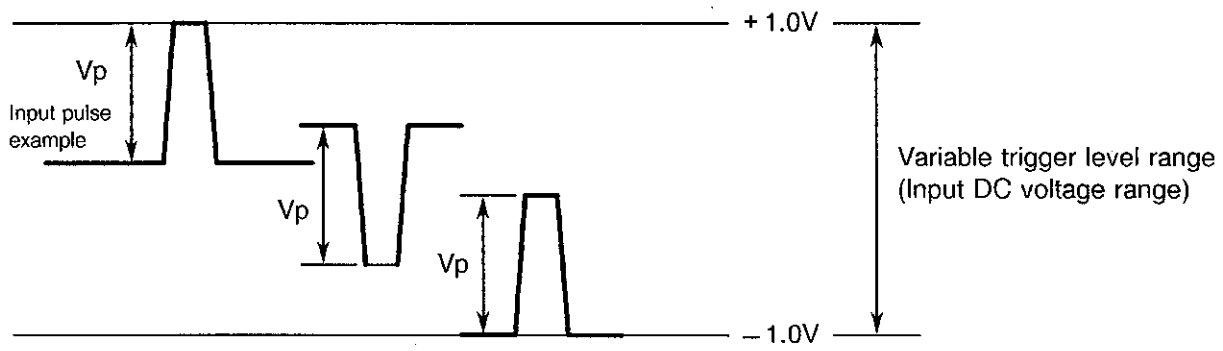
 Indicates the hysteresis level.

Figure 2-19 Setup in input coupling mode

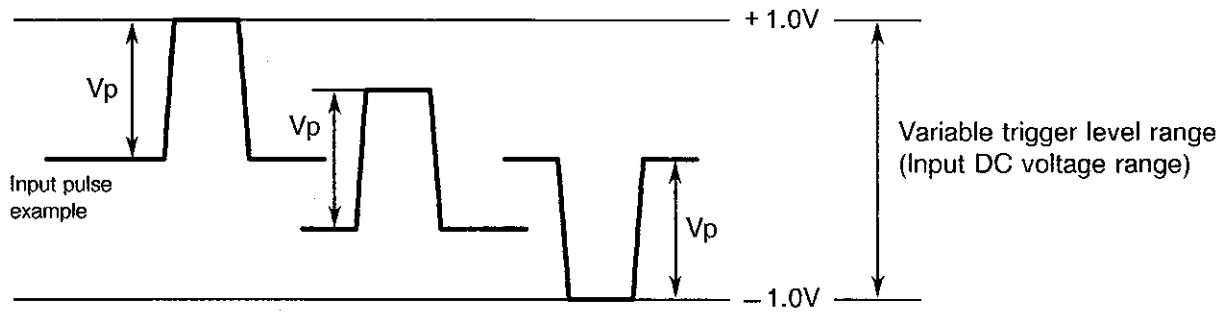
The counter provides the following relationship between the variable trigger level range and the maximum input signal amplitude (see Figure 2-20).

(a) **SENSITIVITY X1**



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

(b) **SENSITIVITY X10**



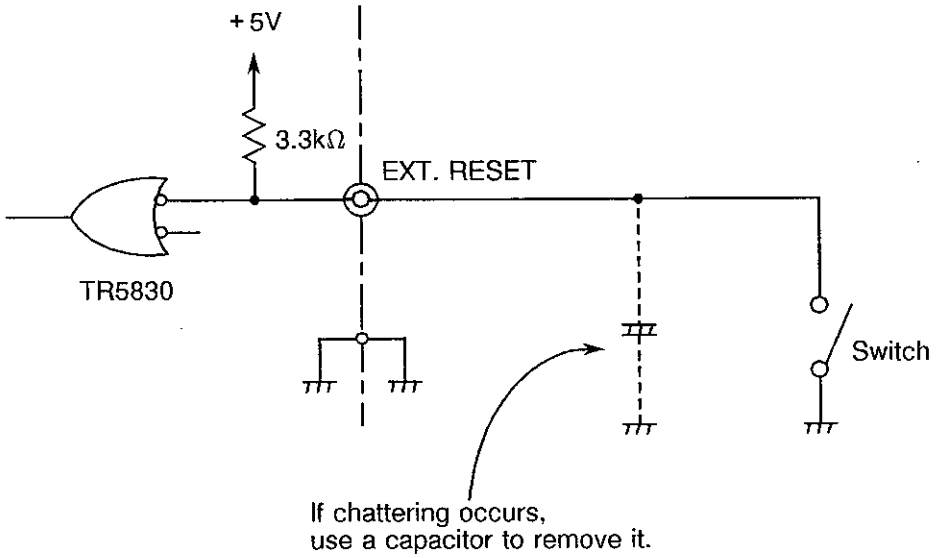
Vp: 14.0 Vp-p (Approx. 5 Vrms) maximum input signal amplitude

Figure 2-20 Relationship between variable trigger level range and maximum input signal amplitude

2.15 Using the External Reset Signals

When the **SAMPLE RATE** control is set to **HOLD** and when the external reset signal is entered, the counter starts measurement.
A single measurement is made when the reset signal is entered. The counter stops until the next reset signal is entered.
The external reset signal can be entered into the **RESET** connector on the counter rear panel. The following signals must be used.

① When the contact signal is used, the external reset signal cable must be connected as shown in Figure 2-21. In this case, the counter is reset immediately the contact is closed. The counter starts operation immediately. (However, when the signal under test is not entered, the counter remains in idle state.)



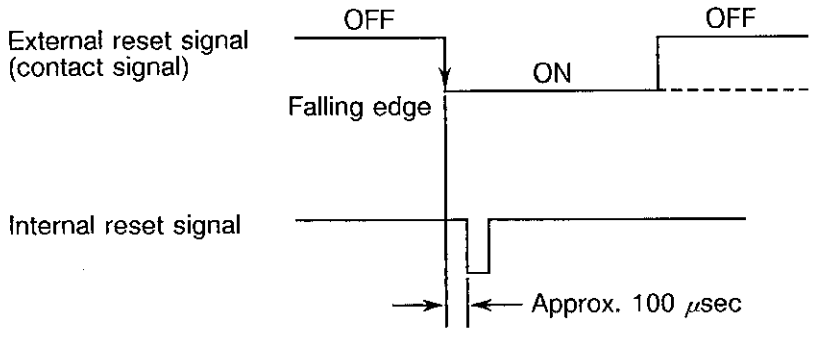


Figure 2-21 External reset by contact signal

② Use the following signals for external reset (as shown in Figure 2-22).
Logical high: +5 to +2.4 V
Logical low: 0 to +0.4 V
The negative edge (TTL level) of the signal causes a reset, and the counter starts operating immediately. (However, when the signal under test is not entered, the counter remains in idle state.)
Any positive or negative pulse signal can cause a reset (however, the negative edge triggers the reset).
The minimum pulse width of the reset signal is 1 microsecond. The system circuit must be designed to accept a current larger than 2 mA since "Low" level output current is around 2 mA.

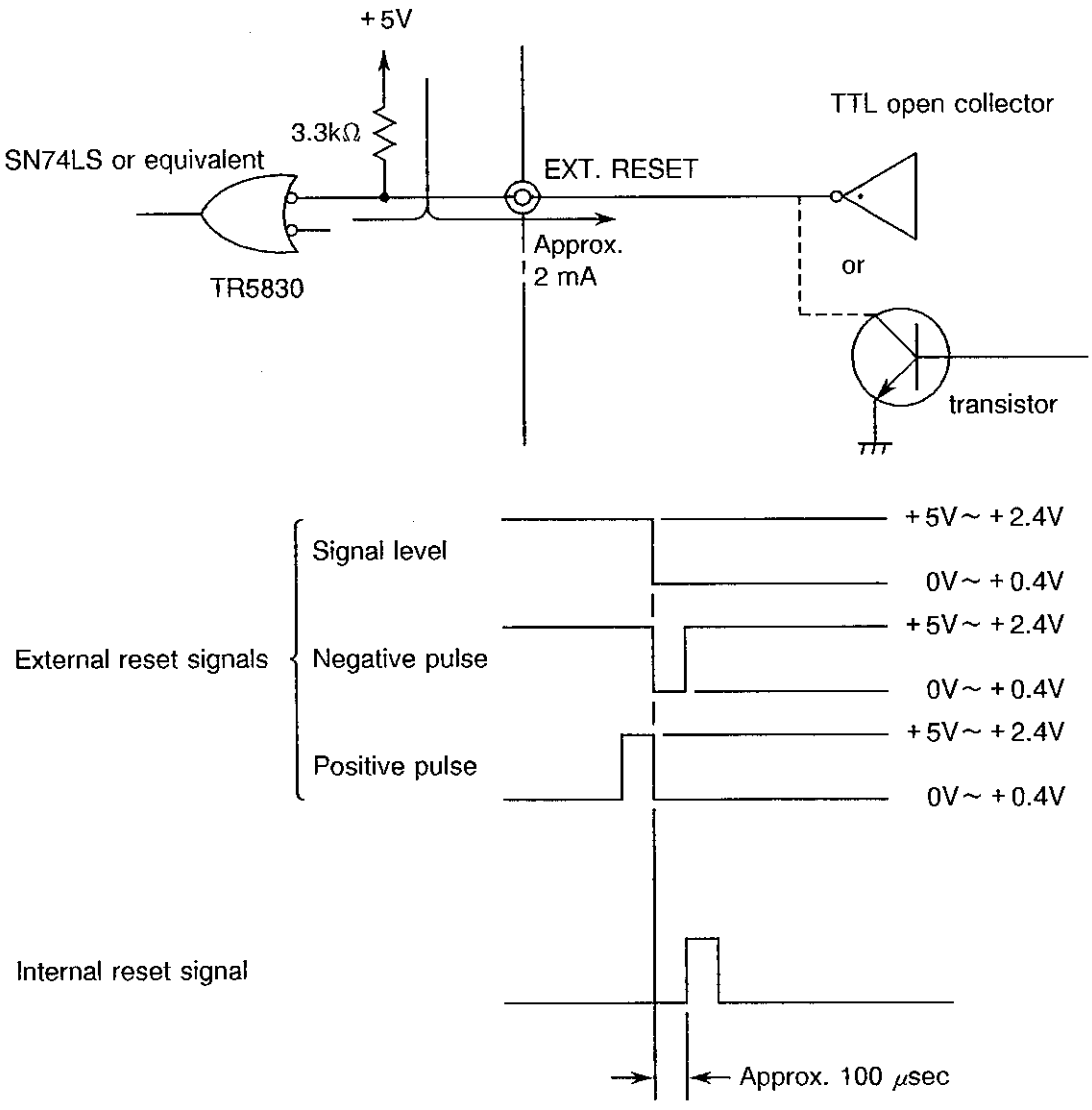


Figure 2-22 External reset by electric signal

2.16 Checking Measurement Performance

This section explains how to check the performance of the counter during frequency, period, time interval, frequency ratio, phase and time ratio measurement. It also explains the measurement accuracy and measuring time in each mode.
Before checking measurement performance, turn the **POWER** switch **ON** and run the counter for 30 minutes or more.
The numerical values given in this section are obtained when an internal reference time of 5 x 10^{-10}/day aging rate (**TR5830D**) is used.

2.16.1 Checking performance during frequency/period measurement

(a) Checking procedure (at **INPUT A**)

① Connect a 50-ohm coaxial cable between the **INPUT A** connector and the **STD OUTPUT** connector on the rear panel.

② Set the **FUNCTION** to "**F**" (or "**P**").

③ Set the **SAMPLE NUMBER** to 10^3.

④ Set the **STATISTICS** to "σ".

⑤ Set the "**EXT. START DELAY**" to any position other than **FAST STARTING**. Make sure that the indicator goes out.

⑥ Rotate the **SAMPLE RATE** control to the point immediately before the **HOLD** position.

⑦ Set the **EVENT** to 10^0. (Make sure that the **ENTRY** indicator goes out.)

⑧ Set **MNR**.

(Release the **ENTRY** data.)

⑨ Release **MNR**.

⑩ Make sure that "**DISP. MASK**" has been released (the "**DISP. MASK**" indicator must go out).

⑪ Make sure that "**LEV.**" is released (the corresponding LED must go out).

⑫ Set the signal input conditions for **INPUT A** as follows:

IMPEDANCE	**50Ω**
SENSITIVITY	**×1**
COUPLING MODE	**AC**
SLOPE	**+**
LEVEL	**PRESET**
	SYN.

Release **LPF** (the corresponding LED must go out).

⑬ Press **RST.**

The display must be as follows:

If the **FUNCTION** has been set to "**F**"

M 0.0 /000 MHz or less

If the **FUNCTION** has been set to "**P**"

M 0. /000 nsec or less

(b) Checking procedure (at **INPUT B**)

Connect a 50-ohm coaxial cable between the **INPUT A** connector and the **INPUT B** connector on the rear panel, and check the performance using the same procedure described in (a).

The display must be as follows:

If the **FUNCTION** has been set to "**F**"

M /.000 kHz or less

If the **FUNCTION** has been set to "**P**"

M 0.0 /00 nsec or less

(c) Checking procedure if option-21 C input unit is mounted

① Connect a 50-ohm coaxial cable between the 100MHz, 500 mVrms signal source of the sine wave oscillator (having a 40 dB or higher S/N ratio), and the INPUT C connector.

② Set the **FUNCTION** to "**F**" (or "**P**").

③ Set the **SAMPLE NUMBER** to 10^3.

④ Set the **STATISTICS** to "σ".

⑤ Set the "**EXT. START DELAY**" to any position other than **FAST STARTING**. Make sure that the indicator goes out.

⑥ Rotate the **SAMPLE RATE** control to the point immediately before the **HOLD** position.

⑦ Set the **EVENT** to 10^0. (Make sure that the **ENTRY** indicator goes out.)

⑧ Set **MNR.**

(Clear the **ENTRY** data.)

⑨ Release **MNR.**

⑩ Make sure that "**DISP. MASK**" has been released (the "**DISP. MASK**" indicator must go out).

⑪ Make sure that "**LEV.**" is released (the corresponding LED must go out).

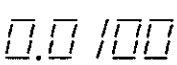
⑫ Set the signal input conditions for **INPUT C** as follows:

SENSITIVITY	X1
ANS	Release (The corresponding LED must go out.)

⑬ Press **RST.**
The display must be as follows:
If the **FUNCTION** has been set to "**F**"

M  kHz or less

If the **FUNCTION** has been set to "**P**"

M  nsec or less

(d) Measuring accuracy (period)

$$\frac{\pm 700\ \text{ps} \pm \sqrt{2}\ \text{Trigger error (*)}}{\text{Specified event count}} \pm \text{Reference time accuracy} \quad \text{—①}$$

$$\text{* Trigger error (sec rms)} = (9.2 \times 10^{-5} + 0.23E_N) \cdot \frac{T}{E_S}$$

E_N: Noise voltage of the signal under test (Vrms)
E_S: Voltage of the signal under test (Vrms)
T: Period of the signal under test (sec)

Measuring accuracy (frequency)

$$\pm (\text{Frequency measured})^2 \times \left(\begin{matrix}\text{Frequency} \\ \text{measuring error}\end{matrix}\right)^{(*1)} \pm (1/3\text{LSD max.})^{(*2)} \quad \text{—②}$$

*1: Expression ①
*2: The LSD is the least significant digit of the frequency measured.

(e) Measuring speed

Period measurement:

$$\left(\begin{matrix}\text{Specified counter operation} \\ \text{time (*1) + Approx. 13 msec}\end{matrix}\right)^{(*1)} + \left(\begin{matrix}\text{Specified sample} \\ \text{rate time}\end{matrix}\right)$$

Frequency measurement:

$$\left(\begin{matrix}\text{Specified measuring time +} \\ \text{Approx. 50 msec}\end{matrix}\right) + \left(\begin{matrix}\text{Specified sample} \\ \text{rate time}\end{matrix}\right)$$

During statistics calculation

Period measurement:

$$\left(\begin{array}{l}\text{Specified measuring time} + \\ \text{Approx. 8 msec}\end{array}\right) \times \left(\begin{array}{l}\text{Specified} \\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{Statistics calculation} \\ \text{processing time (*2)}\end{array}\right) + \left(\begin{array}{l}\text{Specified sample} \\ \text{rate time}\end{array}\right)$$

Frequency measurement:

$$\left(\begin{array}{l}\text{Specified measuring time} + \\ \text{Approx. 8 msec}\end{array}\right) \times \left(\begin{array}{l}\text{Specified} \\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{Approx. 37 msec} \\ \text{reverse calculation time}\end{array}\right)^{(*2)} + \left(\begin{array}{l}\text{Statistics calculation} \\ \text{processing time (*2)}\end{array}\right) + \left(\begin{array}{l}\text{Specified sample} \\ \text{rate time}\end{array}\right)$$

*1 Specified counter operation time = GATE TIME or
(Specified EVENT count x Time of 1 period)

*2 Statistics calculation processing time:
Up to 20 msec for average ($\bar{X}$),
minimum (**MIN.**) or maximum (**MAX.**) value
Up to 65 msec for standard deviation (σ)

2.16.2 Checking performance during time interval measurement

(a) Checking procedure

① Connect a 50-ohm coaxial cable between the **INPUT A** connector and the **STD OUTPUT** connector on the rear panel.

② Set the **FUNCTION** to "**T.I.**".

③ Set the "**EXT. START DELAY**" to any position other than **FAST STARTING**. Make sure that the indicator goes out.

④ Rotate the **SAMPLE RATE** control to the point immediately before the **HOLD** position.

⑤ Set **MNR**.

(Clear the **ENTRY** data.)

⑥ Release **MNR**.

⑦ Make sure that "**DISP. MASK**" has been released (the "**DISP. MASK**" indicator must go out).

⑧ Make sure that "**LEV.**" has been released (the corresponding LED must go out).

⑨ Set "**SYN.**".

⑩ Set "**COM.**".

⑪ Set the signal input conditions for **INPUT A** and **INPUT B** as follows:

	INPUT A	**INPUT B**
IMPEDANCE	50Ω	
SENSITIVITY	×1	
COUPLING MODE	**AC**	
SLOPE	+	+
LEVEL	**PRESET**	**PRESET**
	Release **LPF**.	

⑫ Press **RST**.

The **STATISTICS** $\overline{X}$ display for the **SAMPLE NUMBER** must be as follows:

SAMPLE NUMBER	10^0 (single pulse)	10^1, 10^2	10^3, 10^4
	$\overline{X}$	**M** ± 1.50ns or less	**M** ± 1.500ns or less
	M ± 1.5ns or less		

(b) Measuring accuracy

$$\pm 2\text{ns} \pm \frac{(\pm 500\text{ps Jitter} \pm \text{Trigger error}^*)}{\sqrt{\text{Sample count}}} \pm \text{Standard time accuracy}$$

$$^* \text{Trigger error} = \frac{\pm 5.6 \times 10^{-4} \pm \text{EN}}{\text{Signal through rate (V/S)}}$$

where, EN is the insertion noise (Vp-p).

(c) Measuring speed

During single pulse measurement:

$$\left(\begin{array}{l}\text{Measuring time interval +}\\ \text{Approx. 13 msec}\end{array}\right) \times \left(\begin{array}{l}\text{Specified}\\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{Specified sample}\\ \text{rate time}\end{array}\right)$$

During statistics calculation

$$\left(\begin{array}{l}\text{Measuring time interval +}\\ \text{Approx. 8 msec}\end{array}\right) \times \left(\begin{array}{l}\text{Specified}\\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{Statistics calculation}\\ \text{processing time (*)}\end{array}\right) + \left(\begin{array}{l}\text{Specified sample}\\ \text{rate time}\end{array}\right)$$

* See Item (e) of Section 2.16.1 for details.

2.16.3 Checking performance during time ratio or phase measurement

(a) Checking procedure

① Connect a 50-ohm coaxial cable between the **INPUT A** connector and the **STD OUTPUT** connector on the rear panel.

② Set the **FUNCTION** to "**T.R.**" (or **PH**).

③ Set the **SAMPLE NUMBER** to 10^3.

④ Set the "**EXT. START DELAY**" to any position other than **FAST SAMPLING**. Make sure that the indicator goes out.

⑤ Rotate the **SAMPLE RATE** control to the point immediately before the **HOLD** position.

⑥ Make sure that "**DISP. MASK**" has been released (the "**DISP. MASK**" indicator must go out).

⑦ Release "**LEV.**" (the corresponding LED must go out).

⑧ Set "**COM.**" (the corresponding LED must light).

⑨ Set the signal input conditions for **INPUT A** and **INPUT B** as follows:

	INPUT A	**INPUT B**
IMPEDANCE	**50Ω**	
SENSITIVITY	**×1**	
COUPLING MODE	**AC**	
LEVEL	**PRESET**	**PRESET**
	Release **LPF.**	

⑩ Press **RST**. The "**PH**" and "**T.R.**" display during **SLOPE** setup must be as follows:

	SLOPE +/-	**SLOPE** -/+
T.R	Around **M** 4.0000 -01	Around **M** 6.0000 -01
PH	Around **M** -144.0000 DEG	Around **M** 144.0000 DEG

(b) Calibration during phase measurement (**PH**)

① Connect the signal cables under test to the **INPUT A** and **INPUT B** connectors.

② Set the **FUNCTION** to **PH**.

③ Set the **SAMPLE NUMBER** to 10^3.

④ Set "**SEP.**".

⑤ Set the **SLOPE** to " + " at **INPUT A** and "-" at **INPUT B**.

Set the other parameters for correct phase measurement.

Operating procedure:

ⓐ Rotate each **LEVEL** control of **INPUT A** and **INPUT B** so that the indicator shows almost zero.

ⓑ Plug one signal cable under test into the **INPUT B** connector.

ⓒ Measure the signal phase.

(c) Measuring accuracy

$$\pm 360\text{DEG} \times \frac{\text{Time interval measuring error (sec)}}{\text{Period (sec)}}$$

where,

SAMPLE NUMBER	Measuring period count
10^0	10^1
10^1	10^1
10^2	10^2
10^3	10^2
10^4	10^3

The measuring period changes automatically.

(d) Measuring speed

Phase measurement:

$$\left(\begin{array}{l}\text{Measuring time interval +}\\ \text{Approx. 8 msec)}\end{array}\right) \times \left(\begin{array}{l}\text{Specified}\\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{No. of measuring periods}\\ \times \text{ Time of 1 period}\end{array}\right) + \begin{array}{l}\text{Approx.}\\ \text{46 msec}\end{array} + \left(\begin{array}{l}\text{Specified sample}\\ \text{rate time}\end{array}\right)$$

Time ratio measurement:

$$\left(\begin{array}{l}\text{Measuring time interval +}\\ \text{Approx. 8 msec)}\end{array}\right) \times \left(\begin{array}{l}\text{Specified}\\ \text{sample count}\end{array}\right) + \left(\begin{array}{l}\text{No. of measuring periods}\\ \times \text{ Time of 1 period}\end{array}\right) + \begin{array}{l}\text{Approx.}\\ \text{41 msec}\end{array} + \left(\begin{array}{l}\text{Specified sample}\\ \text{rate time}\end{array}\right)$$

2.16.4 Checking performance during frequency rate measurement

(a) Checking procedure

Check the frequency measurement performance for **INPUT A** and **INPUT B** using the same procedure described in Section 2.16.1.

(b) Measuring accuracy

$$\text{Minimum value;} \quad \frac{\text{Period of denominator} - \text{Maximum error during denominator period measurement}}{\text{Period of numerator} + \text{Maximum error during numerator measurement}}$$

$$\text{Maximum value;} \quad \frac{\text{Period of denominator} + \text{Maximum error during denominator period measurement}}{\text{Period of numerator} - \text{Maximum error during numerator measurement}}$$

(c) Measuring time

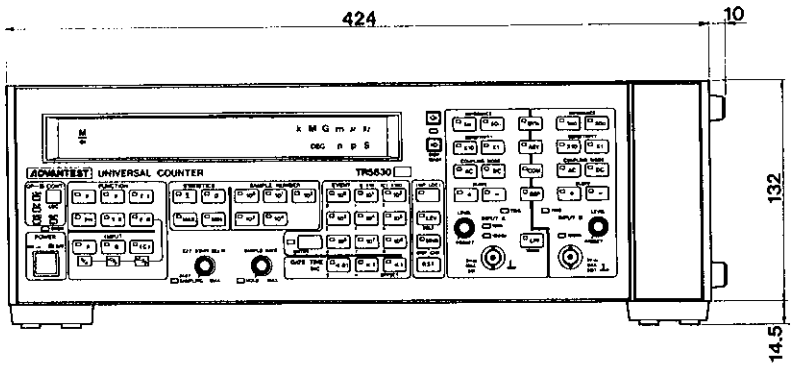
$$\left(\begin{array}{l}\text{Measuring time with numerator}\\ \text{specified + Approx. 7 msec}\end{array}\right) + \left(\begin{array}{l}\text{Measuring time with}\\ \text{denominator specified}\end{array}\right)$$

$$+ \begin{array}{l}\text{Approx.}\\ \text{46 msec}\end{array} + \left(\begin{array}{l}\text{Sample rate}\\ \text{time}\end{array}\right)$$

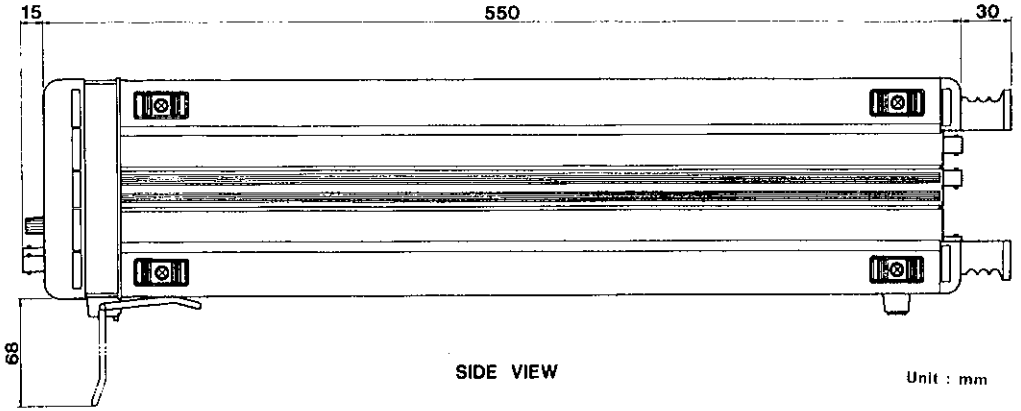
where,

Specified measuring time = GATE TIME or
= Specified EVENT count × Time of 1 period

MEMO

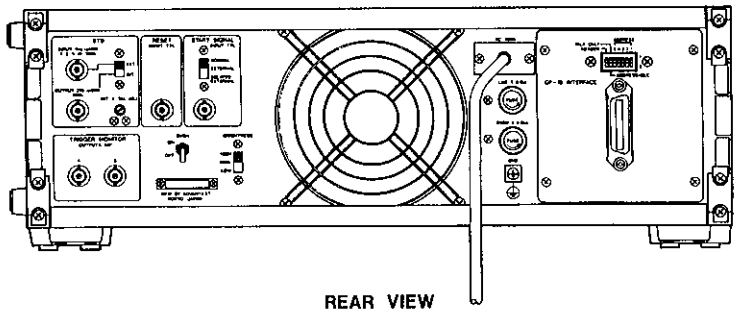


FRONT VIEW

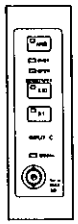


SIDE VIEW

Unit : mm



REAR VIEW



INPUT C

TR5830
EXTERNAL VIEW

IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in Advantest. Advantest hereby grants you a license to use the SOFTWARE only on or with Advantest PRODUCTS.

Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from Advantest.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

Liability

Advantest shall have no liability (1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than it's intended use) of the SOFTWARE. (2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

ADVANTEST®

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500