ADVANTEST

ADVANTEST CORPORATION

TR5834/35

PULSE JITTER COUNTER

INSTRUCTION MANUAL

MANUAL NUMBER OEB01 9602

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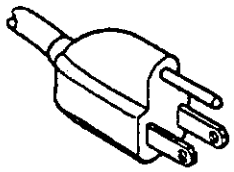
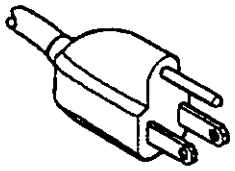
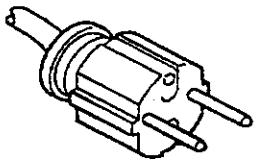
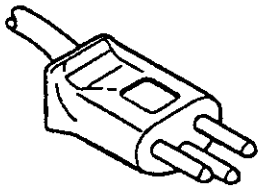
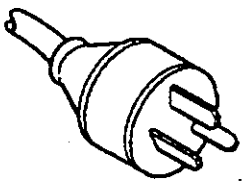
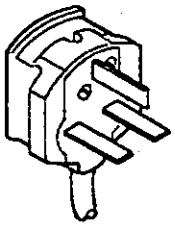
Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

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

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1. GENERAL DESCRIPTION

1.1 GENERAL

The TR5834/5835 Pulse Jitter Counter is a time measurement counter which, in addition to ordinary counter functions that measure pulse width and period in the display resolution of 1 ns/100 ps, simultaneously provides a function to discriminate signals with high accuracy, and another to statistically process measurement values.

The discriminating function includes a window function which sets a highly accurate absolute time range and extracts and measures only those signals falling in the range, and an external start function which, after starting with a specific applied signal that is synchronized with an input signal, waits for an arbitrary, highly accurate, absolute time period or an arbitrary number of input signals, and starts the measurement. The external start function, in particular, has a wide range of applications because it also enables a similar delay operation at the end of the measurement.

To realize a time measurement of high resolution, the "Time Expansion Method" which is an ADVANTEST's original accurate time measurement technology (patented in Japan, U.S.A., and West Germany) is used in the measurement section of the counter.

Five types of statistical evaluation functions (standard deviation, range, maximum, minimum, mean) make it easy to know the distribution status of measurement values. The counter has a mode which enables the number of measurement data to be set arbitrarily making for flexible measurement depending on the actual conditions.

The input section of this counter is designed so that a 10:1 probe for oscilloscope may be used, and its compensation capacitance is easily adjusted.

If a GPIB adaptor (TR13007A) is used, all operations from the front panel of this counter can be set remotely (in the case of TR5835, the extended functions of TR15001 may also be set) and D/A conversion output can also be obtained. When a BCD output unit (TR13006A) is used, this counter can give its measurement value in a parallel BCD output form and, at the same time, the D/A conversion output can be used. (In comparison mode, the TR5835 incorporated with TR15001 can give its judgment results in a logical signal form.)

If a Key Unit (TR15001) is incorporated, the TR5835 can extend its function to enable the move operations (range, maximum, minimum), comparison, and automatic setting of trigger level. Numeric parameters such as trigger level and window may then be entered through the number keys.

In addition, this pulse jitter counter has the following features:

- The trigger level can be set in digital form within the range of ±5V. The setting resolution is 5 mV for TR5834 and 2.5 mV for TR5835.
- Thorough anti-EMI technology is used to lower the level of radiation.
- Setting contents can be preserved for 2 weeks.
- This counter is compact, light-weighted, and portable.

1.2 SPECIFICATIONS

When a slash (/) is used, the figure before the slash is for TR5834 and the figure after the slash is for TR5835.

Pulse Width Measurement

Measurement range	: 5 ns to 9.99999999 s
Signal repetition rate	: Up to 100 MHz
Mean value measurement	: Number of data can be arbitrarily set within the range 10 to 10000. (In addition, fixed values of 200 and 800 may be set.)
Display resolution	: At normal measurement : 1 ns/100 ps At mean value measurement: 100 ps/10 ps (with less than 1000 data) or 10 ps/1 ps (with 1000 or more data)
Measurement accuracy	: ±2 ns/1.5 ns ± (trigger error) ± (reference time accuracy)
Display time unit	: s, ms, µs, ns
Measurement mode	: Positive pulses or negative pulses can be selected.

Period Measurement

Measurement range	: 10 ns to 9.99999999 s
Signal repetition rate	: Up to 100 MHz
Mean value measurement	: Number of data can be arbitrarily set within the range 10 to 10000. (In addition, fixed values of 200 and 800 may be set.)
Display resolution	: At normal measurement : 1 ns/100 ps At mean value measurement: 100 ps/10 ps (with less than 1000 data) or 10 ps/1 ps (with 1000 or more data)
Measurement accuracy	: ±2 ns/1.5 ns ± (trigger error) ± (reference time accuracy)
Display time unit	: s, ms, µs, ns
Measurement mode	: Positive periods or negative periods can be selected.

Input

Coupling mode	: DC
Impedance	: 50 Ω or approx. 1 MΩ//35 pF or less can be selected.
Sensitivity voltage	: With square waves: 60 mVp-p With sine waves : $\frac{7 \times 10^4}{\text{Frequency (Hz)}}$ (at 3 MHz or lower) 3 mVrms (at 3 MHz to 80 MHz) 23 mVrms (at 80 MHz to 100 MHz)
Signal slew rate	: 0.5 V/μs or more is required.
Maximum voltage	: ±6 V (DC + AC peak)
Fusing voltage	: ±6.25 V (DC + AC rms) at 50 Ω
Destructive overload	: At 1 MΩ, ±150 V (DC + AC peak) for 100 kHz or lower ±70 V (DC + AC peak) for 10 MHz or lower ±7 V (DC + AC peak) for 100 MHz or lower
Trigger level	: Range to be set : -5 V to +5 V, variable or fixed at 0 V Resolution to be set : 5 mV/approx 2.5 mV Accuracy to be set : ±25 mV (at 1 MΩ input)
Input terminal	: BNC connector

Waveform Monitor Output

Use	: Compensation and adjustment when a probe for oscilloscope is used.
Probe to be used	: Tektronix P6109B or its equivalent
Impedance	: Approx. 450 Ω
Voltage amplitude	: With a 5 Vp-p input and a 50 Ω load, approx. 250 mVp-p
Output terminal	: BNC connector

Window function

Use	: This function is used to extract and measure a signal whose pulse width or period falls in a certain time range.
Setting method	: The lower limit and higher limit of a designated time range are set as WINDOW-L and WINDOW-H in digital form.
H/L setting range	: Range A is from 12.5 ns to 1.25 ms (in steps of 12.5 ns), and range B is from 1.25 μs to 125 ms (in steps of 1.25 μs). To select either range, use a switch on the rear panel.
H/L setting accuracy	: ±20 ns (range A) or ±2.0 μs (range B)

External Start Function

① Time delay mode

Use	: This mode is used to synchronize the measurement timings with an external signal. By means of time, it is possible to independently delay the time taken from an applied external signal to the measurement start edge, and also delay the time taken from the applied external signal to the measurement end edge.
Range to be set	: 12.5 ns to 1.25 ms (for both measurement start and measurement end)
Delay of start signal	: 150 ns ± 20 ns (for both measurement start and measurement end)

② Event count delay mode

Use	: This mode is used to synchronize the measurement timings with an external signal. By means of input signal count, it is possible to independently delay the time taken from an applied external signal to the measurement start edge, and also delay the time taken from the applied external signal to the measurement end edge.
Range to be set	: 1 to 100000 (for both measurement start and measurement end)
Restriction	: Repetition rate of the input signal is up to 20 MHz
Delay of start signal	: 150 ns ± 20 ns

③ Specifications of start signal

Logic level	: TTL
Enable edge	: Leading edge
Repetition rate	: Up to 10 MHz
Minimum pulse width	: 50 ns
Input terminal	: BNC connector

Window Monitor Output

Logic level	: TTL
Function	: Shows the operation status of the window function when it is used.
Output terminal	: BNC connector

Trigger Level Monitor Output

Function	: Outputs a trigger level voltage (-5 V to +5 V) which has been set.
Output terminal	: PTJ terminal (test jack)
Output impedance	: Approx. 10 kΩ

Time Base

Internal reference frequency: 10 MHz

Aging rate : 5×10^{-8}/day, 1×10^{-7}/month, 2.5×10^{-7}/year

Temperature : $\pm 1 \times 10^{-7}$ (at $+25^{\circ}C \pm 25^{\circ}C$)

Warm-up characteristics : $\pm 2 \times 10^{-7}$ after 10 minutes,
$\pm 1 \times 10^{-7}$ after 30 minutes

Internal reference output: Frequency: 10 MHz,
Voltage : approx. 1 V0-p (with a 50 Ω load)

External reference input : Frequency: 10 MHz,
Voltage : approx. 2 V0-p to 5 V0-p

Statistical Operation Function

Operation contents : Standard deviation (σ)
: Sample standard deviation in acquired data (this is displayed to 2/3 significant digits)
Range (RANGE)
: Difference between the maximum value and the minimum value in acquired data
Maximum value (MAX)
: Maximum value in acquired data
Minimum value (MIN)
: Minimum value in acquired data
Mean value (MEAN)
: Arithmetic mean value

Sample number : Number of data to be acquired. 1, 200, 800, or an arbitrarily set value (10 to 10000).

Display time unit : s, ms, μs, ns, ps

Operation results : To be obtained at sample rate time HOLD

Measurement Speed

① At normal operation (when the window function is not used).

Short cycle: (Measured pulse width or period + 3 ms/770 μs) x (sample number) + (operation time) + (sample rate time)

Long cycle : (Measured pulse width or period + 5.5 ms/1.5 ms) x (sample number) + (operation time) + (sample rate time)

② When the window function is used.

Short cycle: (Tx + 340 μs/110 μs) x N + (Tx + 3 ms/770 μs) x (sample number) + (operation time) + (sample rate time)

Long cycle : (Tx + 340 μs/110 μs) x N + (Tx + 5.5 ms/1.5 ms) x (sample number) + (operation time) + (sample rate time)

where
Tx: Measured pulse width or period
N : Number of invalid data which have been acquired
Operation time: 200 ms (max)

Test Function

Use	:	Checks the operation of the measurement section.
Display value: TR5834	:	100 ns ± 1 ns,
TR5835	:	100.0 ns ± 1.0 ns.

General Specification

Count capacity	:	9 decimal digits
Display method	:	Yellowish green 7-segment LED, storage display method, mesh filter
Sample rate time	:	Approx. 10 ms, approx. 160 ms, approx. 1.3 s and infinite (HOLD)
Panel settings storage	:	They are stored for 2 weeks in the standard operation status.
Operational environment	:	Temperature: 0 to +40°C, Humidity : 40 to 90 %
Storage temperature	:	-20 to +60°C
Power supply	:	90 to 132 Vac (this can be changed to 180 to 249 Vac depending on the specifications), 50 to 400 Hz
Power consumption	:	65 VA/85 VA or less
Dimensions	:	Approx. 240 (W) x 88 (H) x 360 (D) mm
Weight	:	5 kg or less

1.3 OPTIONAL ACCESSORIES

(1) TR13006 BCD Data Output Unit (for TR5834 only)

Transfer method	: Digit parallel, 50 pins, Amphenol connector or its equivalent (57LE-40500-27C0)
Connected device	: TR6198 Digital Recorder, etc.
Number of output digits	: 9 digits
Output level	: TTL, positive logic
D/A output	: The 4 lower digits of a display value are output in the range 0 to 9.999 V. Resolution of 4096 points, a BNC connector, an ON/OFF switch for output (with an impedance of approx. 100 Ω).

Note: If a TR13006 unit is installed onto a TR5835 counter, print contents are not guaranteed during TR15001-related operation (particularly in comparison mode).

(2) TR13006 BCD Data Output Unit (for both TR5834 and TR5835)

In addition to the specifications of TR13006, the following is provided.

Comparison result	: To be given by a logic signal (when a TR15001 is also used).

(3) TR13007 GPIB Adaptor (for TR5834 only)

Standards	: IEEE STD. 488-1978
Interface function	: SH1, AH1, T5, L4, SR1, R1, PP0, DC1, DT1, C0
Used code	: ASCII
Remote setting contents	: All operations from the front panel are performed.
D/A Output	: The 4 lower digits of a display value are output in the range 0 to 9.999 V. Resolution of 4096 points, a BNC connector, an impedance of approx. 100 Ω.
Transfer display	: It is possible to display controller-indicated values on the counter.

Note: If this unit is installed onto a TR5835 counter, the remote setting of TR15001-related function is not possible.

(4) TR13007A GPIB Adaptor (for both TR5834 and TR5835)

Among the specifications of TR13007, the following is changed.

Remote setting contents	: All operations from the front panel, and the extended function when a TR15001 is also used.

(5) TR15001 Key Unit (for TR5835 only)

Setting of numeric parameters: Trigger level, window, sample number, and delay amount can be set through the numeric keys.

Move operation : The moving values of RANGE, MIN, and MAX can be measured.

Comparison : GO-NG judgment is possible in 2 modes. A judgment signal is obtained if a TR13006 is also used.

Auto-level mode : When a pulse width is measured, the trigger level is automatically set.

(6) TR16204A Carrying Case

(7) A02801 Front Cover

(8) A02017 Panel Mount Set

(9) A02621 EIA Rack Mount Set

(10) A02621-J JIS Rack Mount Set

(11) A02622 EIA Rack Mount Set for Using TR15001

(12) A02622-J JIS Rack Mount Set for Using TR15001

1.4 ACCESSORIES SUPPLIED

(1) 10:1 Voltage Probe (Tektronix P6109B) [AAA-6109B-1] 1

(2) Input Cable [A01036-1500] 2

(3) AC Power Supply Cable [MP-43] 1

(4) AC Power Supply Fuse (normal-blow fuse 1.6A/2.0 A) [TMF51NR1.6/2.0] 2

(5) Input Fuse [275.125] 2

(6) Instruction Manual [E5834/35] 1
In the case of the 180-249 Vac specifications, an normal-blow fuse of 1 A is supplied.

2. OPERATING PROCEDURES

2.1 PRELIMINARY PREPARATIONS AND GENERAL PRECAUTIONS

2.1.1 Inspection

This counter was thoroughly tested at the factory before shipment. However, when you receive this counter, inspect for any visible damage, particularly on the front panel switches and terminals.

If any damage is found or the operation is not satisfactory, please contact your nearest ADVANTEST representative. Their addresses and telephone numbers are at the end of this manual.

2.1.2 Storage

If this counter is not used for a long time, put it in a cardboard box and keep the box in a place away from dampness and direct sunlight.

2.1.3 Cautions about Transportation

When transporting this counter to another place, pack it up with the packaging material used when the counter was first delivered. If the material has been lost, however, pack up the counter in the following way.

① Wrap the counter in vinyl plastic. (Add a desiccative inside so that external humidity will not affect the counter.)
② Wrap the counter in a cushioning material which is at least 40 mm thick, and put it in a cardboard box which is at least 5 mm thick.
③ Put the supplied accessories also wrapped in a cushioning material into the box, together with the counter wrapped in the cushioning material, and close and bind the cardboard box with packing strings.

2.1.4 General Precautions before Use

(1) Power supply voltage
The AC power supply voltage was set before shipment, and its value is indicated near the power supply connector on the rear panel. Use this counter within the indicated voltage range and in the frequency range of 50 to 400 Hz.

(2) Power supply cable
Use the AC power supply cable which is supplied with this counter and ground it in one of the following ways.

a. When the MP-43 cable and the 3-2 pin conversion adaptor (also supplied with the counter) are used, ground the green earth lead of the conversion adaptor.

b. When the MP-43 cable which has a 3-prong plug is used as it is, insert the plug into a 3-prong receptacle. (Then, it is already grounded.)
c. If it is not possible to ground through the plug of the power cable, use the ground terminal on the rear panel.

(3) Replacement of power supply fuse
Apply a Phillips-head screwdriver into the slot of the fuse holder and, while lightly pressing the holder, rotate the screwdriver about 60 degrees counterclockwise. Then, release the screwdriver and the rotary portion of the fuse holder will come out about 3 mm. Pull out this rotary portion and change the old fuse with a new one. To install the rotary portion again, apply the screwdriver and rotate about 60 degrees clockwise. (See Figure 2-1.)

CAUTION

Before replacing the fuse, be sure to disconnect the AC power supply cable from the counter. Just setting the POWER switch to STBY does not mean that the power supply line to the fuse is cut off.

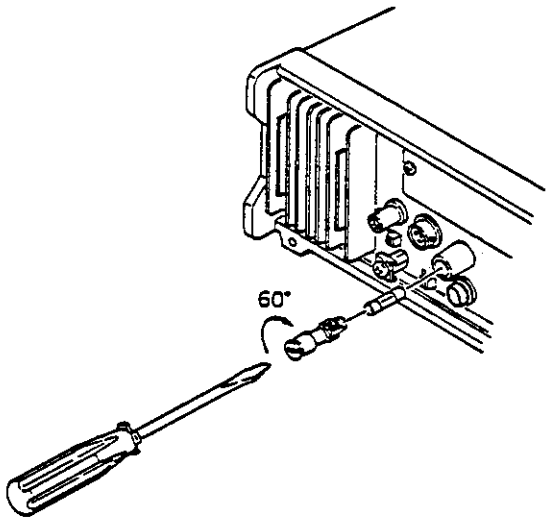


Figure 2-1 Replacement of Power Supply Fuse

(4) Environment
Avoid the use of this counter in places where such undesirable environmental conditions as dust, direct sunlight, and corrosive gas are observed. Use this counter in the ambient temperature range of 0 to 40°C and humidity range of 40 to 90%.

(5) Shock
This counter uses a crystal oscillator, so care is required when handling the counter to avoid giving the oscillator a serious mechanical shock.

(6) Repair of 10:1 voltage probe
If the voltage probe which is supplied with this counter becomes faulty, send it directly to this manufacturer (Tektronix) for repair.

(7) New purchase of 10:1 voltage probe
To purchase a new 10:1 voltage probe, contact its manufacturer (Tektronix) directly. A charge will be added for its purchase through ADVANTEST. Note that a probe made by another manufacturer may also be used if its compensation capacitance adjustment range includes 35 pF at 100 MHz or higher.

(8) STBY (standby) status
When the POWER switch is set to STBY, if the power supply plug is inserted into an AC receptacle, the reference oscillation circuit starts its operation by entering into the measurement standby status. Because, in the STBY status, the Ni-Cd backup battery which supports the storage of panel setting contents is put in the charge mode, this STBY status may also be used as a means of extending the storage time.

(9) Selection of reference time signal
By means of the STD INT OUT/EXT IN switch on the rear panel, either an internal signal or an external signal is selected at the reference time signal. If the switch is set to STD INT OUT, the internal reference time signal is selected and it is output simultaneously. If the switch is set to STD EXT IN, an external 10 MHz (2 to 5 V0-p) signal is used as the reference time signal.

(10) Master reset
When the POWER switch is turned ON, if the RESET key is pressed at the same time, a master reset operation starts and leads the counter into its initialization status (described in (3) of Section 2.3.4) without regard to the stored setting contents. Use this master reset function to initialize the numeric parameters.

2.2 PANEL DESCRIPTIONS

Figure 2-2 shows views of the counter from the front, rear, top and right side. As the function of each component is explained in the numbered sequence shown in the figure, refer to Figure 2-2 when necessary.

-- Front Panel --

① POWER switch
This switch is used to turn the secondary side of the power transformer ON and OFF. If this switch is pressed in, it turns ON and all the circuits start their operation. If the switch is pressed again, it comes out, entering into STBY status. In STBY status, if the power supply cable is connected to an AC receptacle, the power is supplied to the oscillation circuit, the multiplication circuit, the thermostatic oven heater and the Ni-Cd battery, and the OVEN lamp lights. Note that in STBY status, the power is through the power supply fuse. So, when replacing the fuse, disconnect the power supply cable at its connector end or plug end.

② STATISTICS block
This block is used to select 5 types of statistical operations: standard deviation (σ), range (RANGE), minimum value (MIN), maximum value (MAX), and mean value (MEAN). The display of σ is given to 2 significant digits (3 significant digits for TR5835). The operation whose lamp is ON is to be executed.

If  is pressed, the ON lamp moves one place to the right and another operation is selected. And, when the key is released, "0.0" is displayed once, a measurement is performed and the newly selected operation is executed. Similarly, if  is pressed and released, another operation, one place to the left, is selected, "0.0" is displayed once, a measurement is performed and the new operation is executed.

If  is pressed while the σ lamp is ON or if  is pressed while the MEAN lamp is ON, CYCLE RATE CHANGE (switching of the measurement speed) is executed. That is, in either case, each time a key is pressed, the SHORT CYCLE lamp repeats blinking. During this operation, the ON status of the σ lamp or MEAN lamp is maintained. After the key is released, "0.0" is displayed once and a measurement is performed at the newly selected measurement speed.

When SAMPLE RATE has been set to HOLD, if  or  is pressed, the selection of a statistical operation or a measurement speed is done, but neither "0.0" is displayed nor any measurement is performed. Only the operation result based on the previous measurement is displayed.

③ FUNCTION block
This block is used to select 3 types of measurement functions: pulse width (WIDTH), period (PERIOD), and checking the measuring section by an internal signal (TEST).
The measurement function whose lamp is ON is selected now. If ⇨ is pressed, the ON lamp moves one place to the right and another function is selected. When the key is released, "0.0" is displayed once and a measurement of the newly selected function starts.

While TEST lamp is ON, if ⇨ is pressed, the ON lamp returns to the left end and WIDTH is selected.

④ SAMPLE NUMBER block
This block is used to set the number of data to be acquired (i.e. SAMPLE NUMBER) in statistics operations. If ⇨ is pressed, the ON lamp moves one place to the right and another sample number is selected.

When 1, 200 or 800 is selected and ⇨ is released, "0.0" is displayed and a measurement automatically starts. If VARIABLE is selected, VARIABLE lamp lights, the currently set sample number (which is a variable value) is displayed, and, even after ⇨ is released, the variable status is maintained. To change the variable value, use ⇧ or ⇩. To start a measurement, press the RESET key.

If ⇨ is pressed while VARIABLE lamp is ON, the ON lamp returns to the left end and 1 is selected. while 1 is selected, wherever the STATISTICS lamp lights, original measured data are displayed. (That is, the selection of sample number 1 means that the STATISTICS function has been cancelled.) To change an already set variable value while a measurement using the VARIABLE function is in progress, ⇨ must be pressed 4 times first.

⑤ OVEN lamp
This lamp indicates that the power is being supplied to the built-in crystal oscillator of the counter. While this lamp lights and the reference signal switch (23) is set to INT OUT, a 10 MHz TTL signal is output as the crystal oscillator output signal through the STD connector (32).

⑥ SAMPLE RATE key and HOLD lamp
This key is used to control the repetition speeds of measurement by changing the measurement rest time. By pressing this key, the sample rate can be changed like 10 ms (approx.) → 160 ms (approx.) → 1.3 s (approx.) → ∞ → 10 ms (approx.) ..., thus enabling to set 4 types of rest time. When the sample rate is set to ∞, the HOLD lamp lights simultaneously. When, as a special case, window values are being set, this key functions to change the setting value being displayed, from a higher limit value to a lower limit value or from a lower limit value to a higher limit value. When a lower limit value is being displayed, "L" (for Low) appears at the lowest digit position of the numeric indicator and, when a higher limit value is being displayed, "H" (for High) appears.
Similarly, when external start delay values are being set, this key functions to switch a setting value from a delay value for measurement start to a delay value for measurement end or from a delay value for measurement end to a delay value for measurement start. When a delay value for measurement start is being displayed, "L" appears at the lowest digit position of the numeric indicator and, when a delay value for measurement end is being displayed, "H" appears.

⑦ RESET (RETURN) key
This is a manual reset key. If this key is pressed during a measurement, the current status is cleared and a new measurement starts. When SAMPLE RATE is HOLD, use this key to start a measurement. In any of the numeric setting modes (VARIABLE of SAMPLE NUMBER, LEVEL, WINDOW, and delays of external start), if this key is pressed, the operation returns (RETURN) to the normal measurement status and a measurement starts.
When the POWER switch is turned ON, if this key is pressed at the same time, it operates as the master reset key and performs initialization as described in (3) of Section 2.3.4.
In either case, if pressing this key is recognized, "0.0" is displayed once.

⑧ 50 Ω key and 50 Ω ON lamp
The 50 Ω key is used to switch the input impedance. When the 50 Ω ON lamp is ON, the input impedance is approx. 50 Ω and, when the lamp is OFF, the input impedance is approx. 1 MΩ 35 pF or less.

⑨ INPUT connector
This is the input connector for measured signals. A fuse is contained within the connector so that when the input impedance is 50 Ω, the input circuit is protected from breakdown. Unless an excessive input (±6.25 V or more) is applied, the fuse does not blow. When the fuse blows out, however, replace it with a new fuse by referring to Section 2.17.

⑩ WINDOW key, WINDOW ON lamp and WINDOW OFF lamp
The WINDOW key is used to enter and clear the window (discriminating) function. When the WINDOW ON lamp lights, the window function is entered and, when the WINDOW OFF lamp lights, the window function is cleared.
In EXT START mode, because the window function is not effective, even when WINDOW ON lamp is ON, the window function is not entered by this key.

⑪ OUTPUT connector
The input signal, immediately before its waveform is shaped, is output as a monitor signal through this connector. If this monitor output is observed with a termination of 50 Ω, its voltage amplitude is about one twentieth of the INPUT connector signal. When a 10:1 voltage probe for oscilloscope is connected to the INPUT connector, this monitor output is used when adjusting the compensation capacitance of the probe.

⑫ WINDOW DISPLAY key or setting value decrease key
In the status of a measurement (or after the RESET key is pressed), if  is pressed first, the currently set lower limit value of a window (or a measurement start delay value in EXT START mode) is displayed. Once any of the numeric setting modes (VARIABLE of SAMPLE NUMBER and LEVEL, in addition to the above mentioned WINDOW and EXT START delay) has started, the function of  is simply to decrease the display value.
To return to the normal measurement status, press the RESET (RETURN) key ⑦.

⑬ LEVEL DISPLAY key or setting value increase key
In the status of a measurement (or after the RESET key is pressed), if  is pressed first, the currently set trigger level value is displayed. Once any of the numeric setting modes (VARIABLE of SAMPLE NUMBER, WINDOW and EXT START delay, in addition to the above mentioned LEVEL) has started, the function of  is simply to increase the display value.
To return to the normal measurement status, press the RESET (RETURN) key ⑦.

⑭ SHORT CYCLE lamp
When this lamp lights, the operation is performed at the faster speed among 2 possible measurement speeds. When the lamp is OFF, the operation is performed at the slower measurement speed. Switching the measurement speed is done in STATISTICS block.
While the operation is in progress at the slower speed, a special compensation operation is performed for measurement values. But if the operation is proceeding at the faster speed, this compensation is omitted.

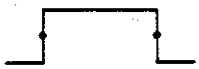
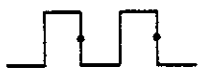
⑮ LEVEL key, LEVEL 0 V lamp and LEVEL ON lamp
The LEVEL key is used to set the trigger level to a preset value (0 V) or to a numerically set value. When the LEVEL 0 V lamp lights, it is in the preset status. When the LEVEL ON lamp lights, the numerically set voltage is applied as the trigger level.

⑯ TRIGGER lamp
If an appropriate trigger level is set for an input signal whose amplitude is equal to or greater than the input sensitivity, the input waveform shaping circuit operates and measurements are performed. When the waveform shaping circuit operates, the TRIGGER lamp turns ON.

⑰ POLARITY key and POLARITY - lamp

is used to select a measuring position, and is effective when FUNCTION is set to WIDTH or PERIOD. Table 2-1 shows 4 types of measuring positions which are possible in combinations of FUNCTION (WIDTH or PERIOD) and POLARITY (+ or -). If POLARITY is set to -, the POLARITY - lamp is turned ON and, if POLARITY is set to +, the polarity - lamp is turned OFF.

Table 2-1 4 Types of Measuring Positions

FUNCTION	POLARITY	Measuring position	Remarks
WIDTH	+		● From a leading slope to a trailing slope ● Positive pulse width
	-		● From a trailing slope to a leading slope ● Negative pulse width
PERIOD	+		● From a leading slope to a leading slope ● Single positive period
	-		● From a trailing slope to a trailing slope ● Single negative period

⑱ Unit display section
This section displays the units of measurement results. Note that when external controller indicated values are displayed via a TR13007/TR13007A GPIB adaptor, the basic units of V and s are not displayed.

⑲ Numeric display section
This display section consists of 9 digits of yellowish green 7-segment LED units, which display the numeric part of measurement results. To prevent radiation, the filter part uses a mesh.

⑳ GATE lamp
When a measurement operation has started, the GATE lamp is turned ON and, when the measurement operation has ended, the lamp is turned OFF. While the window function is used, if some invalid occurred data have exceeded 27 μs (approx.), this lamp may light.

㉑ ERROR lamp
While the higher or lower limit value of a window is set, this lamp lights if the following condition occurs.

(Lower limit value) ≧ (Higher limit value)

If the window function is triggered with values which were set when the ERROR lamp was ON, no effective data occur no matter how long you wait. The limit values must, therefore, be set again.
When the operation moves from the window setting mode to the measurement mode, this lamp is forcibly turned OFF. So, ERROR lamp status should be recognized during the window setting mode.

㉒ RMT lamp
This lamp lights when the functions on the front panel or the extended functions of TR15001 have been remotely set via a TR13007/TR13007A GPIB Adaptor. While the RMT lamp is ON, it is not possible to activate the key switches on the front panel or TR15001.

-- Rear Panel --

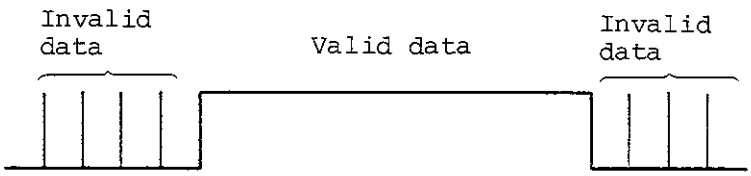
㉓ INT OUT/EXT IN selection switch (STD switch)
If this switch is set to INT OUT (Internal Standard Output), the counter regards the internal crystal oscillator output as the reference time and outputs the 10 MHz reference signal (at TTL level) through the STD connector ㉜ .
If this switch is set to EXT IN (External Standard Input), a 10 MHz, TTL level, external signal which is input through the STD connector ㉜ becomes the reference time of the counter.

㉔ Ground terminal
This terminal is used to ground the counter. If a 2-prong adaptor is connected to the power supply cable, ground the wire coming out of the adaptor or this ground terminal.

㉕ TIME/EVENT selection switch (DELAY switch)
When the counter operates in EXT START mode, this switch is used to select delay types. If the switch is set to TIME, delays in the range 12.5 ns to 1.25 ms can be obtained. If the switch is set to EVENT, delays by means of the number of input signals (i.e. 1 to 100000) can be obtained. These delays can be set separately from a leading edge of the external start signal to the measurement start timing or to the measurement end timing.
In INT START mode (i.e. normal measurement mode), the function of this switch is as follows: if the switch is set to TIME, the higher and lower limit values of a window are set in the range 12.5 ns to 1.25 ms and, if the switch is set to EVENT, the higher and lower limit values are set in the range 1.25 µs to 125 ms.

㉖ LEVEL OUT terminal
Through this terminal, the already set trigger level is output in analog voltage. The output voltage range is from -5 V to +5 V, and the output impedance is approx. 10 kΩ.

㉗ WINDOW MONIT terminal
While the window function is used, the monitor signal which shows the discriminating status of the input signal is output at TTL level through this terminal.



When invalid data occurs as shown above, narrow pulses are output repeatedly (at every 340 µs with TR5834, or 110 µs with TR5835). Each narrow pulse means one invalid data judgment. When data are judged valid, however, the measured value is read and a pulse whose width is 3 ms or more long (770 µs or more for TR5835) is output as the monitor signal. Thus, by checking the frequencies of narrow pulses and wide pulses, it is possible to know whether or not the currently set window range is appropriate.

㉘ AC POWER connector
This is the connector for AC power supply. Use the supplied power supply cable (MP-43).

㉙ Accessory installation space
This space is used to install a TR13006/TR13006A BCD OUT Unit or a TR13007/TR13007A GPIB Adaptor. To install either unit, remove the blank panel.

㉚ Fuse holder
The AC power supply fuse is installed here. When replacing the fuse, refer to Section 2.17. TR5834 uses a 1.6 A normal-blow fuse, and TR5835 uses a 2A normal-blow fuse.

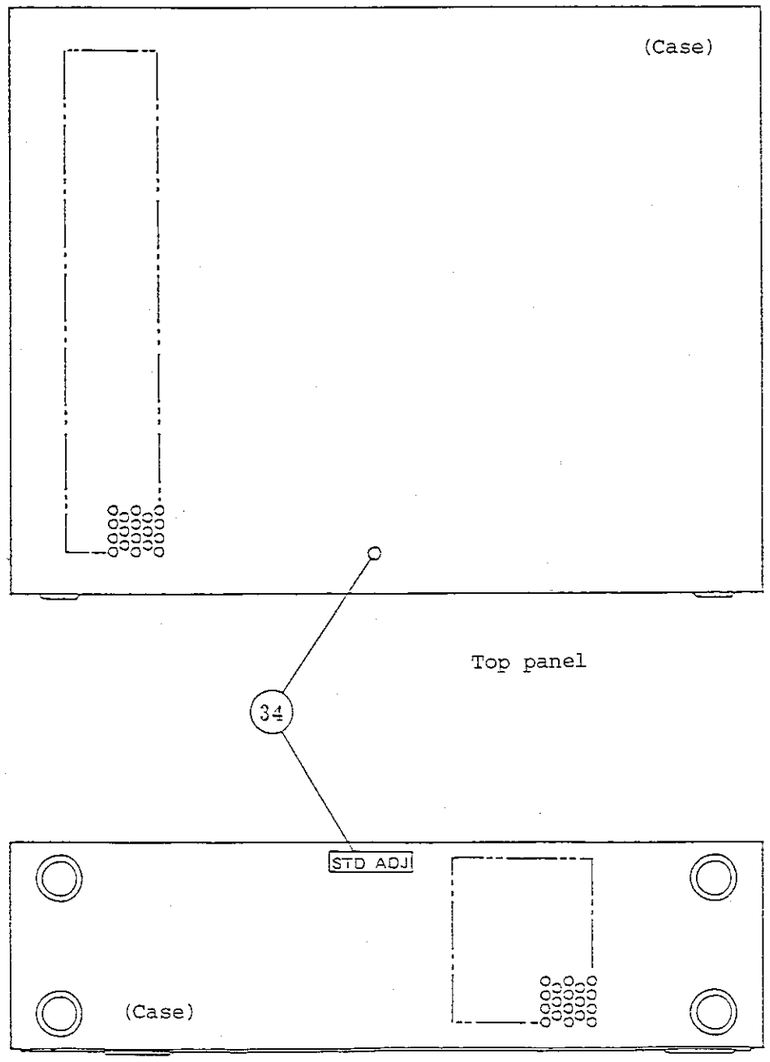
㉛ START SIG IN connector
When the counter operates in EXT START mode, an external start signal is input to this connector. The start signal is assumed to be at TTL level and its repetition rate is up to 10 MHz. The leading edge of the start signal is used as the enable edge.

㉜ STD connector
When the INT OUT/EXT IN selection switch is set to INT OUT, the internal reference signal (10 MHz, TTL level) is output through this connector. If the switch is set to EXT IN, an external reference signal (10 MHz, TTL level), is input through this connector.

㉝ INT/EXT selection switch (START switch)
To synchronize the measurement timing of the counter with an external signal, set this switch to EXT. For this, it is necessary to apply an external synchronization signal to the START SIG IN connector ㉛ and set appropriate delays.
If this switch is set to INT, the measurement timing of the counter is determined by the internal sequence, which is at random with the measured signal.

-- Right side panel, top panel --

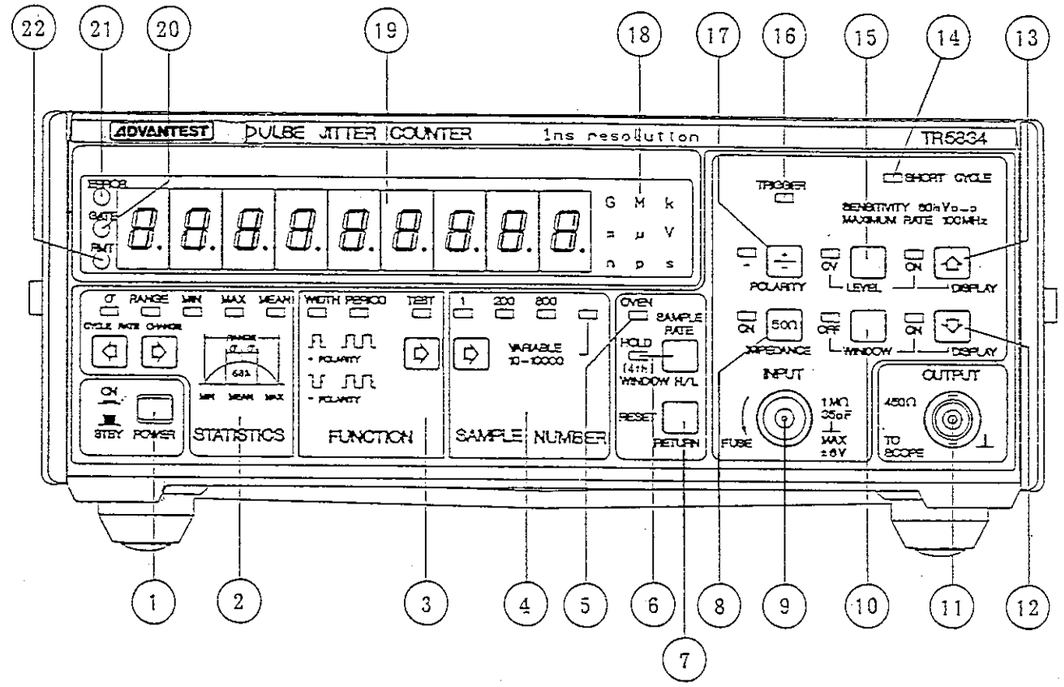
㉞ STD ADJ. control
This adjuster is used to calibrate the internal reference oscillator. The adjustment is done from above the top panel.



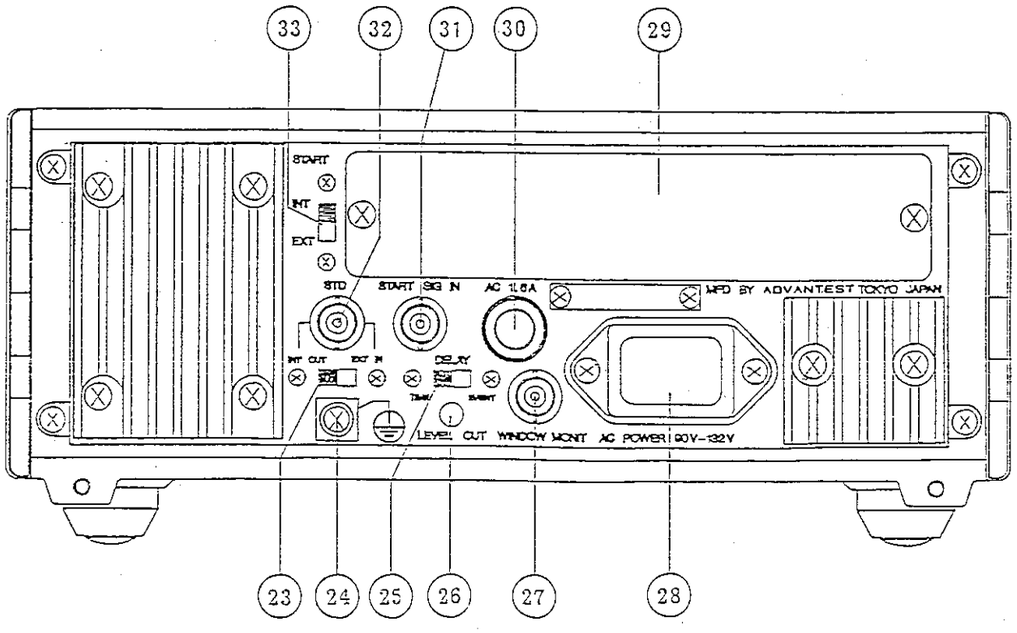
Top panel

Right side panel

Figure 2-2 Panel Descriptions



Front panel (e.g. TR5834)



Rear panel (e.g. TR5834)

2.3 BASIC OPERATING PROCEDURE

2.3.1 Connection of Power Supply

Proceed in the following way.

① Set the POWER switch to STBY.
② Connect (the connector side of) the AC power supply cable (MP-43) to the AC POWER connector on the rear panel.
③ Confirm that the supply voltage of the AC mains receptacle matches the voltage of the counter, and then insert the plug of the power supply cable into the AC receptacle. (The power supply voltage to be used by the counter is printed under the AC POWER connector.)

2.3.2 Selection of Reference Signal

If an external signal is to be used as the reference signal, set the STD switch to EXT IN and then apply the external signal to the STD connector. To switch to the internal signal after the counter has operated with the external signal, disconnect the external signal from the STD connector and set the STD switch to INT OUT. (This procedure is necessary because the STD connector is used for both input and output.)

Note that when the STD switch is set to EXT IN, if no external signal is applied into the STD connector, this counter does not operate.

2.3.3 Confirmation of START Mode

Confirm that the START switch has been set to INT. If the counter is to be used in EXT START mode, confirm that an external start signal is applied to the START SIG IN connector.

Note that if the START switch is set to EXT but no external start signal is applied, the counter does not operate for each function of WIDTH and PERIOD. (Only the TEST function operates.)

2.3.4 Initial Operation

When the POWER switch is turned ON, this counter automatically performs the following (1), (2) and (3).

(1) Self-diagnostics of ROM, RAM, etc.

(2) All the lamps and segments of the display LED units other than RMT and TRIGGER lamps are turned ON for about 3 seconds. (However, LED decimal points are turned ON, one by one, moving from higher digit positions to lower digit positions.)

(3) Initialization

① Setting contents on the front panel
STATISTICS ..... σ
FUNCTION ..... TEST
SAMPLE NUMBER 1
SAMPLE RATE ..... Approx. 10 ms
POLARITY ..... +
IMPEDANCE ..... 1 MΩ
LEVEL 0V
WINDOW ..... OFF
CYCLE RATE ..... SHORT CYCLE

② Setting contents of each value
WINDOW-L ..... 2 µs or 200 µs (by DELAY switch)
WINDOW-H ..... 3 µs or 300 µs (by DELAY switch)
TIME DELAY-L ..... 2 µs
TIME DELAY-H ..... 3 µs
EVENT DELAY-L 200
EVENT DELAY-H 200
LEVEL ..... 0.2 V
VARIABLE SAMPLE NUMBER ... 200

③ Display
99 ns to 101 ns (99.0 ns to 101.0 ns with TR5835). The GATE lamp blinks.

If an error is detected during the self-diagnostics (1), the 9 LED display digits in (2) change to numbers other than 8 or to characters. If this error status appears, please contact your nearest ADVANTEST representative immediately.

The initialization in (3) is done only when the memory backup by the internal Ni-Cd battery is not functioning or when the POWER switch is turned ON together with the pressing of the RESET key. In the latter case, the operations in (1) and (2) are omitted. If the counter is neglected for 2 weeks or longer, the batter voltage will lower and fail to support the memory, so charge the battery before this happens. (While the OVEN lamp lights, the battery is being charged.)

2.4 DIAGNOSTICS OF MEASURING OPERATION

① Set FUNCTION to TEST.
② Set SAMPLE RATE to other than HOLD.
③ Set SAMPLE NUMBER to 200.
④ Set WINDOW key to OFF.
⑤ Depending on the setting of STATISTICS, the display will be as shown in Table 2-2.

Table 2-2 Display by TEST FUNCTION

STATISTICS	Display of TR5834	Display of TR5835
σ	200 ps or less	100 ps or less
RANGE	1.5 ns or less	1 ns or less
MIN	99 ns - 100 ns	99.0 ns - 100.9 ns
MAX	99 ns - 101 ns	99.0 ns - 101.0 ns
MEAN	99.0 ns - 101.0 ns	99.00 ns - 101.00 ns

Note that during measurement operations, the GATE lamp lights.

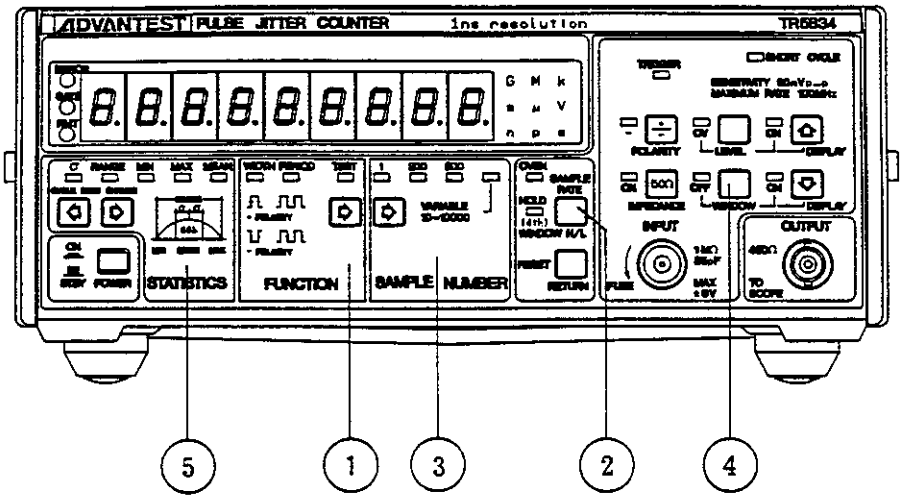


Figure 2-3 Operation Positions in TEST FUNCTION

2.5 SETTING OF SAMPLE NUMBER VARIABLE VALUE

① Newly set SAMPLE NUMBER to VARIABLE. (Then, the previously set contents or the initialization value is displayed.)

② Press  or  to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 1. If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 150 per second. The setting range is from 10 to 10000.)

③ Press the RESET (RETURN) key. (The operation returns to the measurement status.)

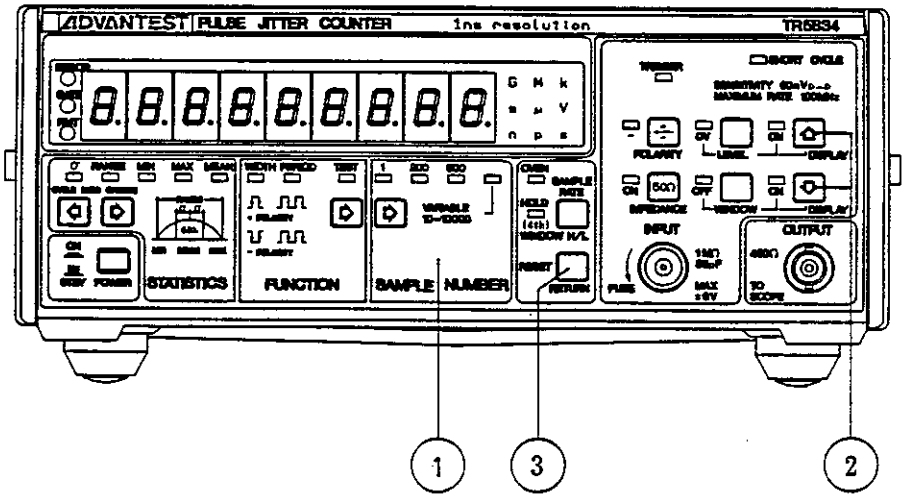


Figure 2-4 Setting of Sample Number Variable Value

2.6 SETTING OF TRIGGER LEVEL

① Press the RESET key (to initialize the current setting status.)

② Press  . (Then, the previously set contents or initialization value of the trigger level is displayed.)

③ Press  or  to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 5 mV (2.5 mV with TR5835). If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 700 mV per second. The setting range is from -5.000 V to +5.000 V.)

④ Press the RESET (RETURN) key. (The operation returns to the measurement status.)

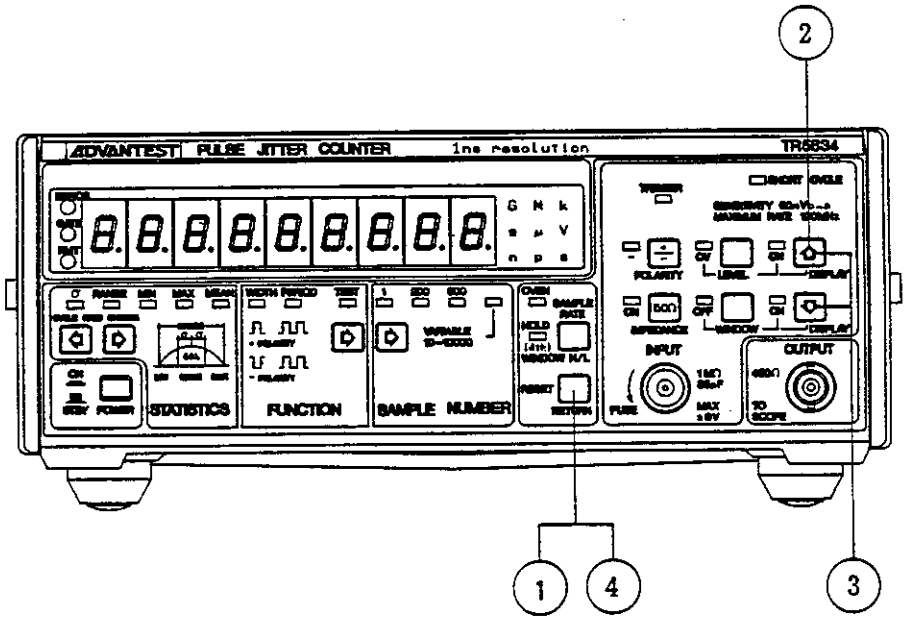


Figure 2-5 Setting of Trigger Level

2.7 SETTING OF WINDOW WIDTH (1)

(When the range is from 12.5 ns to 1.25 ms.)

① Set the START switch on the rear panel to INT (to make the window function available).
② Set the DELAY switch on the rear panel to TIME (to select a setting range).
③ Press the RESET key (to initialize the current setting status).
④ Press  . (The lower limit value of the previously set contents or of the initialization contents is displayed, together with "L" shown at the lowest digit position.)
⑤ Press  or  to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 12.5 ns. If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 2 µs per second.)
⑥ Press the SAMPLE RATE (WINDOW H/L) key. (The higher limit value of the previously set contents or of the initialization contents is displayed, together with "H" shown at the lowest digit position.)
⑦ Press  or  to increase or decrease the setting value.
⑧ Confirm that the ERROR lamp is OFF. (If the ERROR lamp is ON, the values must be set again.)
⑨ Press the RESET (RETURN) key. (The operation returns to the measurement status.)

Note: If this setting mode is entered after performing the Setting of Window Width (2) (Refer to Section 2.8.) or the Setting of Delay Time (Refer to Section 2.9.), note the fact that the previously set contents are not preserved any more because the storage registers are used in common in these setting operations.

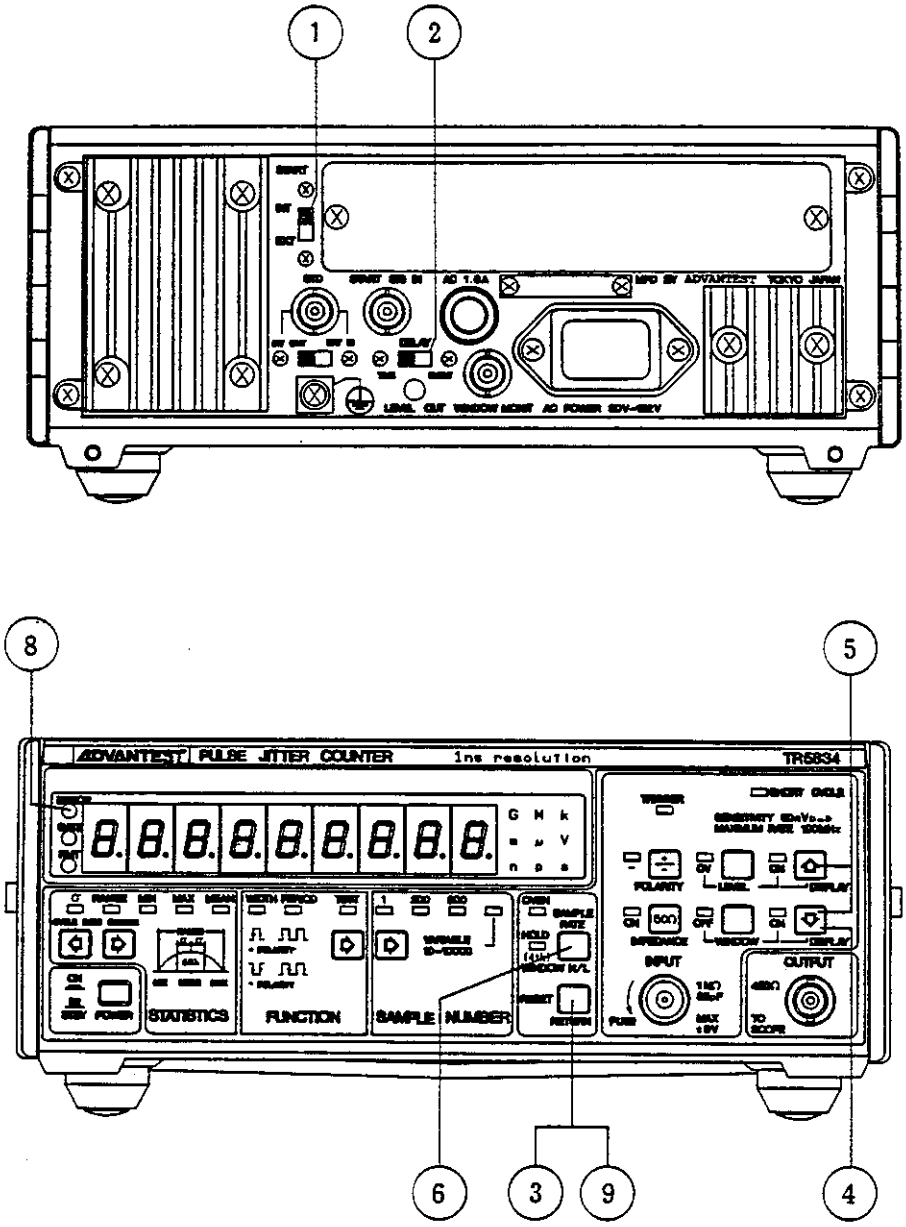


Figure 2-6 Setting of Window Width (1)

2.8 SETTING OF WINDOW WIDTH (2)

(When the range is from 1.25 µs to 125 ms.)

① Set the START switch on the rear panel to INT (to make the window function available).
② Set the DELAY switch on the rear panel to EVENT (to select a setting range).
③ Press the RESET key (to initialize the current setting status).
④ Press  . (Then, the lower limit value of the previously set contents or of the initialization contents is displayed, together with "L" shown at the lowest digit position.)
⑤ Press  or  to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 1.25 µs. If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 200 µs per second.)
⑥ Press the SAMPLE RATE (WINDOW H/L) key. (The higher limit value of the previously set contents or of the initialization contents is displayed, together with "H" shown at the lowest digit position.)
⑦ Press  or  to increase or decrease the setting value.
⑧ Confirm that the ERROR lamp is OFF. (If the ERROR lamp is ON, the values must be set again.)
⑨ Press the RESET (RETURN) key. (The operation returns to the measurement status.)

Note: If this setting mode is entered after performing the Setting of Window Width (1) (Refer to Section 2.7.) or the Setting of Delay Time (Refer to Section 2.9.), note the fact that the previously set contents are not preserved any more because the storage registers are used in common in these setting operations.

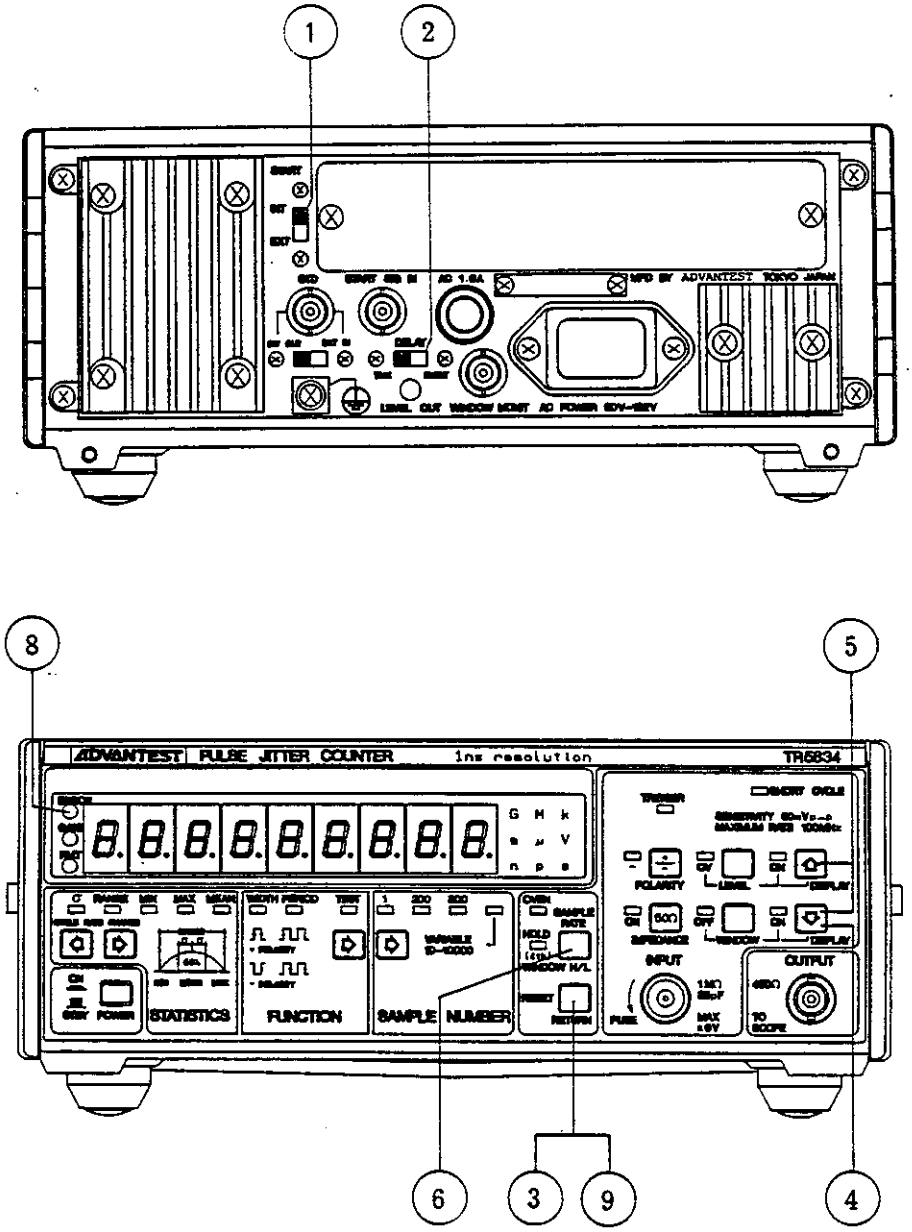


Figure 2-7 Setting of Window Width (2)

2.9 SETTING OF DELAY TIME

① Set the START switch on the rear panel to EXT (to make the external start function available).
② Set the DELAY switch on the rear panel to TIME (to select the time delay type).
③ Press the RESET key (to initialize the current setting status).
④ Press ▽ . (Then, the measurement start delay time of the previously set contents or of the initialization contents is displayed, together with "L" shown at the lowest digit position.)
⑤ Press △ or ▽ to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 12.5 ns. If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 2 µs per second The setting range is from 12.5 ns to 1.25 ms.)
⑥ Press the SAMPLE RATE (WINDOW H/L) key. (The measurement end delay time of the previously set contents or of the initialization contents is displayed, together with "H" shown at the lowest digit position.)
⑦ Press △ or ▽ to increase or decrease the setting value.
⑧ Press the RESET (RETURN) key. (The operation returns the measurement status.)

Note: ● If the following setting condition occurs,

Measurement start delay time (L) ≧ Measurement end delay time (H)

the measurement end delay time is ignored.

● If this setting mode is entered after using the window function, note that the previously set contents are not preserved any more because the storage registers are used in common in these setting operations.

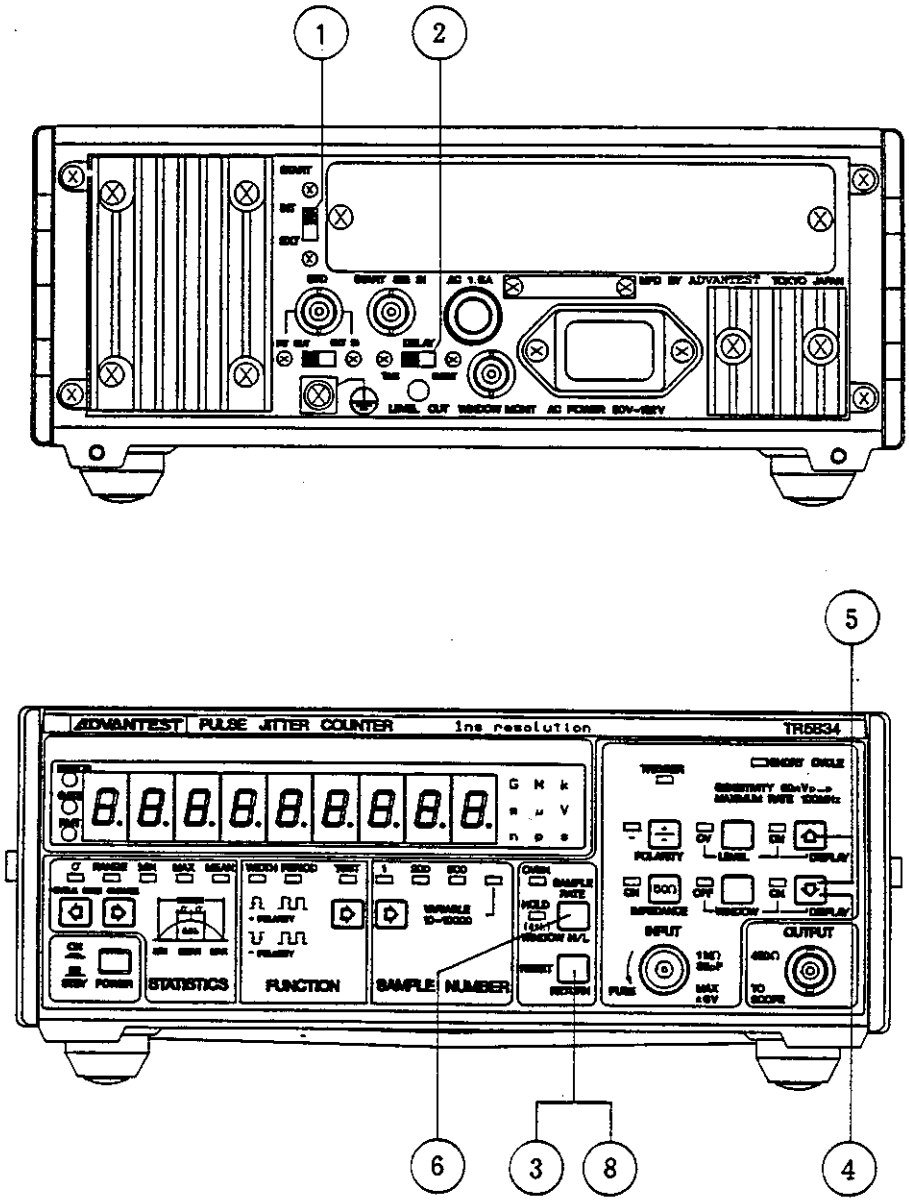


Figure 2-8 Setting of Delay Time

2.10 SETTING OF DELAY EVENT COUNT

① Set the START switch on the rear panel to EXT (to make the external start function available).
② Set the DELAY switch on the rear panel to EVENT (to select the event delay type).
③ Press the RESET key (to initialize the current setting status.)
④ Press  . (Then, the measurement start delay event count of the previously set contents or of the initialization contents is displayed, together with "L" shown at the lowest digit position.)
⑤ Press  or  to increase or decrease the setting value. (Each time either key is pressed, the setting value changes by 1. If you keep pressing either key for about 2 seconds or more, the value changes quickly at a rate of about 150 per second. The setting range is from 1 to 100000.)
⑥ Press the SAMPLE RATE (WINDOW H/L) key. (The measurement end delay event count of the previously set contents or of the initialization contents is displayed, together with "H" shown at the lowest digit position.)
⑦ Press  or  to increase or decrease the setting value.
⑧ Press the RESET (RETURN) key. (The operation returns to the measurement status.)

Note: ● If the following setting condition occurs,

$$\text{Measurement start delay event count (L)} \geqq \text{Measurement end delay event count (H)}$$

the measurement end delay event count is ignored.

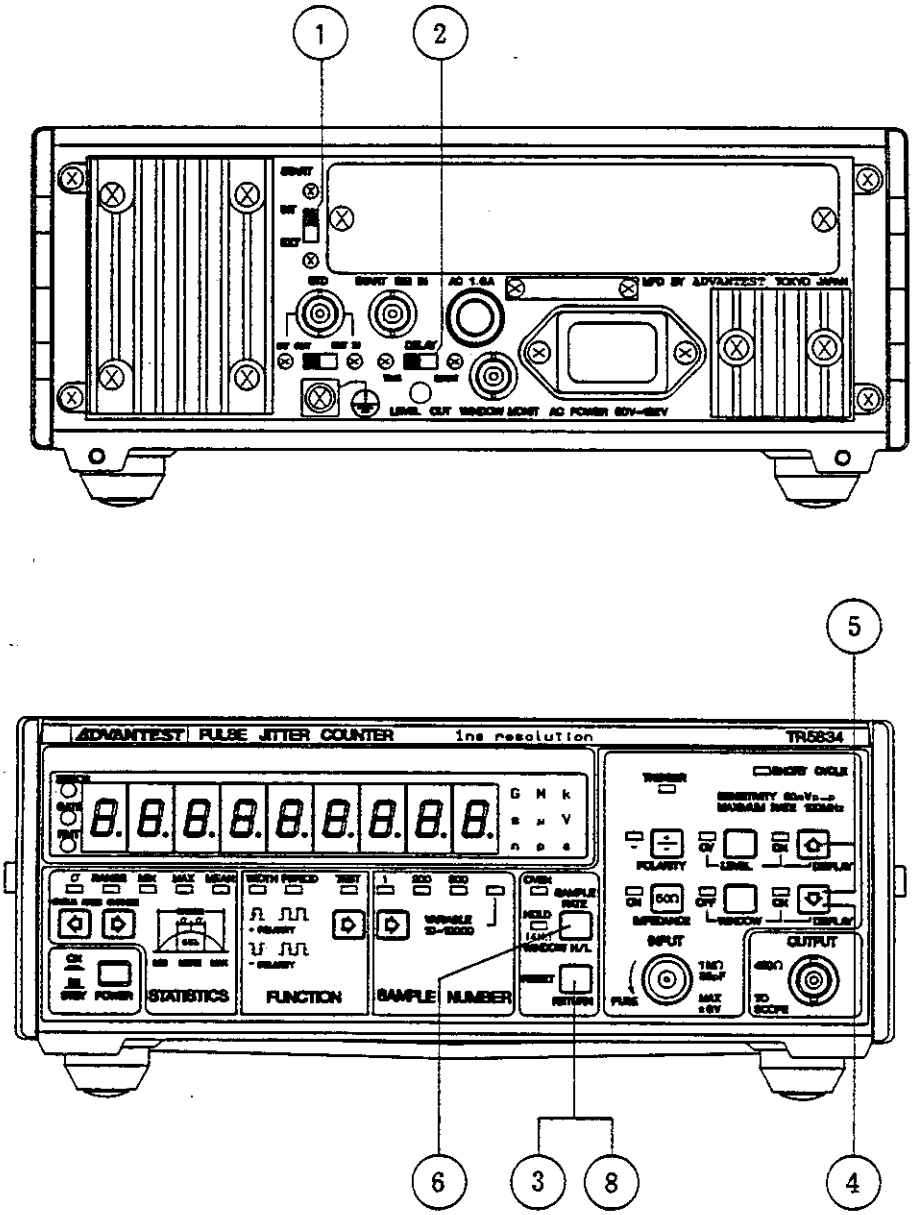


Figure 2-9 Setting of Delay Count

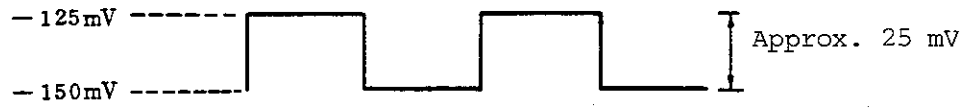
2.11 ADJSUTMENT OF PROBE

The probe which is supplied with this counter (i.e. Tektronix Model P6109B 10:1 voltage probe) was adjusted before shipment. However, if this probe has been lost or damaged and a new probe is to be used, it is necessary to adjust the new probe in the following way.

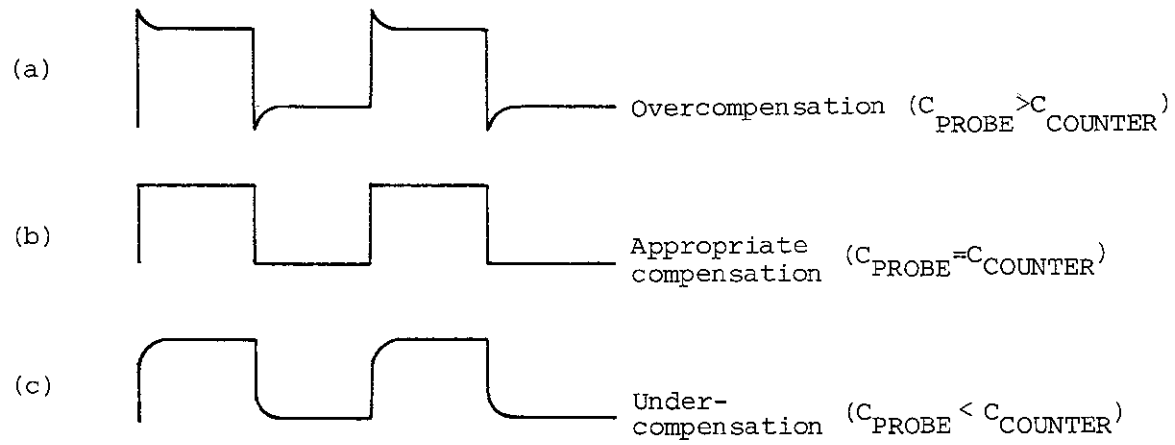
① Connect the new probe to the INPUT connector.
② Set IMPEDANCE to 1 MΩ and press the RESET key.
③ Connect a 50 Ω coaxial cable (MI-02, etc.) between the OUTPUT connector and the input terminal of an oscilloscope (whose bandwidth is 100 MHz or more).
④ Set the input coupling and input impedance of the oscilloscope to DC and 50 Ω, respectively. (If 50 Ω input mode is not available, use a 50 Ω terminator at the input terminal.)
⑤ Apply a square wave signal (which is described below) to the probe. (If the oscilloscope provides a calibration output signal which corresponds to the signal shown below, use it.)

Frequency	: 1 kHz
Duty ratio	: 50 %
Levels	: Low level at 0 V, high level at +5 V
Rise time, fall time	: 10 ns or less
Output impedance	: 1 kΩ or less

⑥ The following waveform will be observed on the oscilloscope screen (at 20 mV/DIV, 0.2 ms/DIV, and an appropriate offset voltage).



⑦ The trimmer capacitor on L which is for the probe and the head portion and the described side is turned so that a waveform like (b) is obtained on the oscilloscope screen.



C_{PROBE} : Compensation capacitance of probe
$C_{COUNTER}$: Input capacitance of TR5834/TR5835

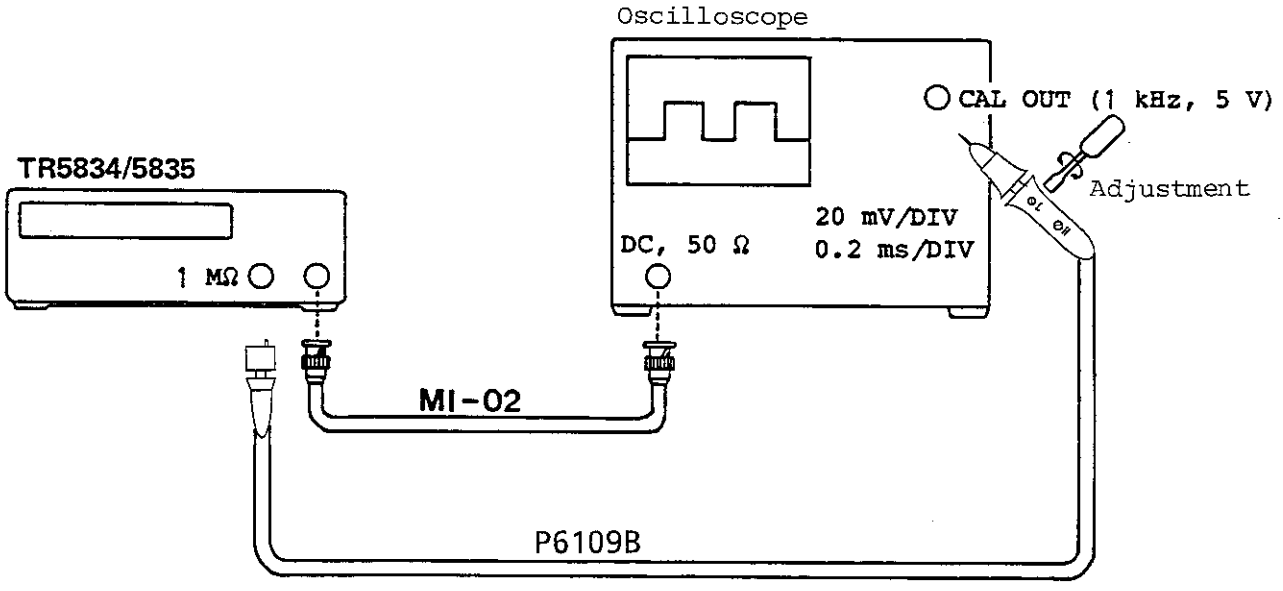


Figure 2-10 Adjustment of Probe

2.12 PULSE WIDTH OR PERIOD MEASUREMENT BY INTERNAL START

① Make sure that the START switch and the STD switch on the rear panel are set to INT and INT OUT, respectively.
② Set FUNCTION to WIDTH or PERIOD.
③ Set SAMPLE NUMBER to 1.
④ Set SAMPLE RATE to other than HOLD.
⑤ Set IMPEDANCE to 50 Ω or 1 MΩ. (If a probe is to be used, set IMPEDANCE to 1 MΩ.)
⑥ To measure a positive pulse width (or a positive period), set the POLARITY key to +. To measure a negative pulse width (or a negative period), set the POLARITY key to -.
⑦ Set the WINDOW key to OFF.
⑧ Set the LEVEL key to 0 V or ON. (If the LEVEL key is set to ON, it is necessary to perform the Setting of Trigger Level (Refer to Section 2.6.) beforehand.)
⑨ Press the RESET key
⑩ Make sure that the TRIGGER lamp is ON. If the TRIGGER lamp is OFF, it means that the trigger level which has been set is not appropriate, or that the amplitude of the input signal to the counter is not large enough (because 60 mVp-p or more is required).
⑪ Make sure that the GATE lamp blinks. (The GATE lamp seems to be ON if the SAMPLE RATE is about 10 ms or less.)
⑫ Check to see if the display value is an expected one. If the display value deviates far from the expected value sometimes, it shows that the trigger level is not appropriate yet.
⑬ If required, set the WINDOW key to ON. (In this case, it is necessary to perform the Setting of Window Width (1 or 2) (Refer to Section 2.7 or 2.8.) beforehand.)
By seeing the display value, make sure that the measurement operation repeats as often as expected. If the measurement frequency is too small, the window width must be reviewed.
⑭ If required, set SAMPLE NUMBER to 200, 800 or VARIABLE. If SAMPLE NUMBER is set to VARIABLE, a reset operation is required to start a measurement. (When using VARIABLE, it is necessary to perform the Setting of Sample Number Variable Value (Refer to Section 2.5.) beforehand.)
Each STATISTICS operation of σ, RANGE, MIN, MAX and MEAN becomes valid.
⑮ If required, perform a CYCLE RATE CHANGE operation. (This is effective when the measurement repetition speed of the counter is not synchronized well with the measured signal.)
⑯ If required, measure statistical operation values simultaneously. (Refer to Section 2.14.)
⑰ If required, observe the output signal of the WINDOW MONIT terminal on the rear panel by an oscilloscope.
⑱ If required, observe the output signal of the LEVEL OUT terminal on the rear panel by an oscilloscope.

2.12 PULSE WIDTH OR PERIOD MEASUREMENT BY INTERNAL START

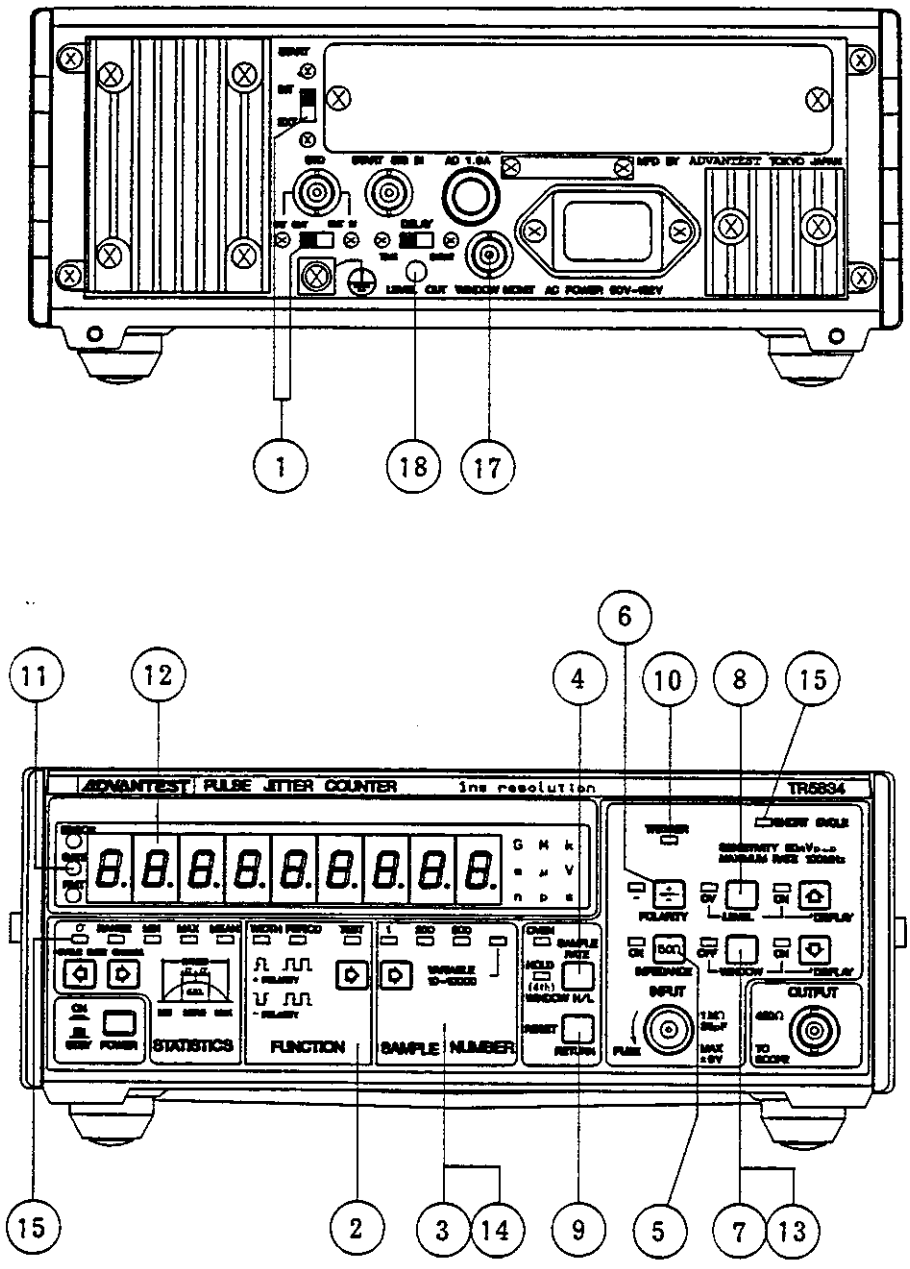


Figure 2-11 Pulse Width or Period Measurement by Internal Start

2.13 PULSE WIDTH OR PERIOD MEASUREMENT BY EXTERNAL START

① Make sure that the START switch and the STD switch on the rear panel are set to EXT and INT OUT, respectively.
② Apply an external start signal (TTL level, repetition rate of up to 10 MHz) to the START SIG IN connector on the rear panel.
③ Set FUNCTION to WIDTH or PERIOD.
④ Set SAMPLE NUMBER to 1.
⑤ Set SAMPLE RATE to other than HOLD.
⑥ Set IMPEDANCE to 50 Ω or 1 MΩ. (If a probe is to be used, set IMPEDANCE to 1 MΩ.)
⑦ To measure a positive pulse width (or a positive period), set the POLARITY key to +. To measure a negative pulse width (or a negative period), set the POLARITY key to −.
⑧ Set the DELAY switch on the rear panel to TIME or EVENT as a delay type.
⑨ If the DELAY switch has been set to TIME, perform the Setting of Delay Time (Refer to Section 2.9.). If the DELAY switch has been set to EVENT, perform the Setting of Delay Count (Refer to Section 2.10.).
⑩ Set the LEVEL key to 0 V or ON. (When setting the LEVEL key to ON, the Setting of Trigger Level (Refer to Section 2.6.) must be done beforehand.)
⑪ Press the RESET key.
⑫ Make sure that the TRIGGER lamp is ON. If the TRIGGER lamp is OFF, it means that the trigger level which has been set is inappropriate, or that the amplitude of the input signal to the counter is too small (because 60 mVp-p or more is required).
⑬ Make sure that the GATE lamp blinks.
⑭ Check to see if the display value is as expected. If the display value sometimes deviates far from the expected value, it shows that the trigger level is not appropriate yet.
⑮ If required, set the SAMPLE NUMBER to 200, 800 or VARIABLE. If SAMPLE NUMBER is currently set to VARIABLE, a reset operation is required to start a measurement. (When using VARIABLE, the Setting of Sample Number Variable Value (Refer to Section 2.5.) must be done beforehand.)
Each STATISTICS operation of σ, RANGE, MIN, MAX and MEAN becomes valid.
⑯ As for CYCLE RATE, SHORT CYCLE is mainly used.
⑰ If required, perform a simultaneous measurement of statistical operation values. (Refer to Section 2.14.)
⑱ If required, observe the output signal of the LEVEL OUT terminal on the rear panel by an oscilloscope.

2.13 PULSE WIDTH OR PERIOD MEASUREMENT BY EXTERNAL START

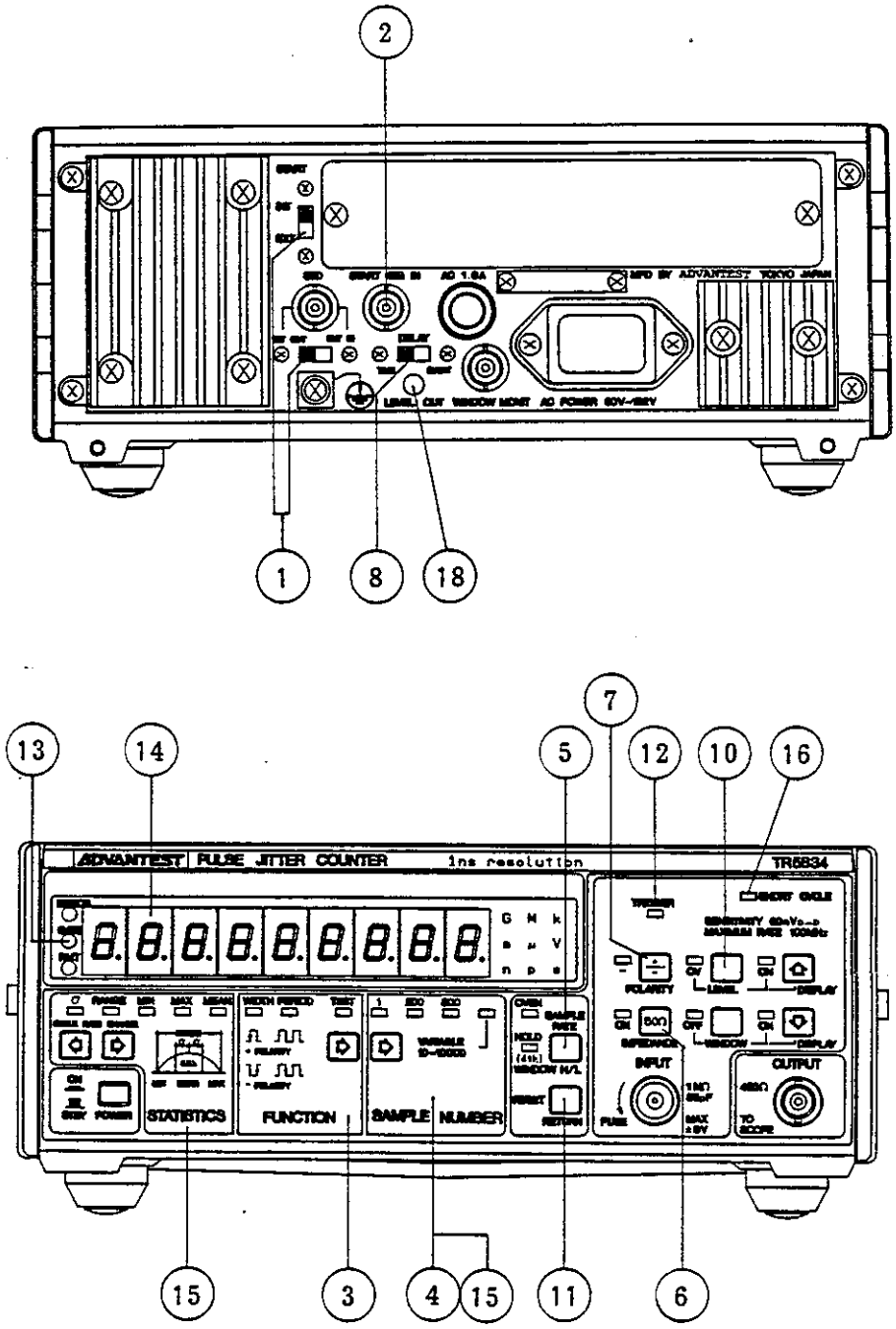


Figure 2-12 Pulse Width or Period Measurement by External Start

2.14 SIMULTANEOUS MEASUREMENT OF STATISTICAL OPERATION VALUES

① Set SAMPLE NUMBER to a value other than 1.
② Set SAMPLE RATE to HOLD.
③ Press the RESET key (to perform a measurement).
④ The statistical operation values of σ, RANGE, MIN, MAX and MEAN are preserved, and each of them can be sequentially selected by using ◁ or ▷ of STATISTICS block. Thus, 5 types of statistical operation values for the same data are obtained.

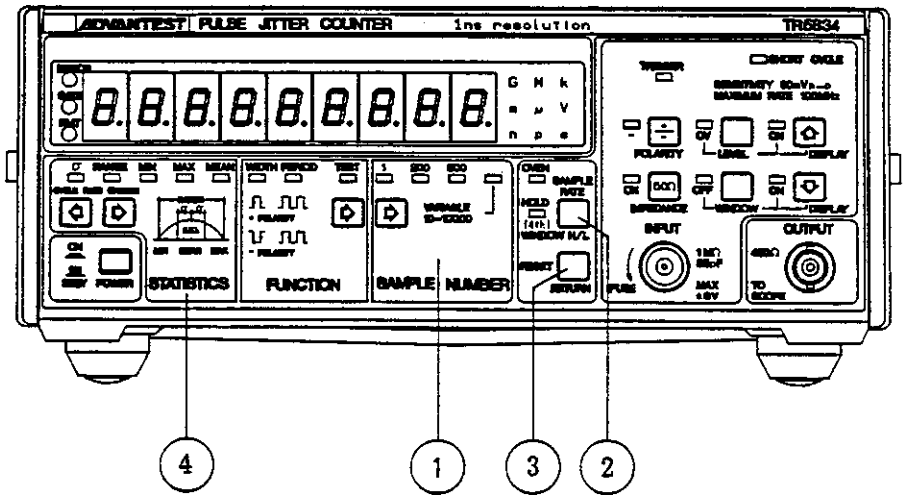


Figure 2-13 Simultaneous Measurement of Statistical Operation Values

2.15 MEASUREMENT OF TWO OR MORE PERIODS

If the settings shown below are made by referring to Section 2.13 " Pulse Width or Period Measurement by External Start", two or more periods (i.e. 2 to 99999 periods) can be measured. However, the measurable signal repetition rate is up to 20 MHz.

① Set FUNCTION to PERIOD.
② Set the DELAY switch on the rear panel to EVENT.
③ Set the measurement start delay count to 1.
④ Set the measurement end delay count to a value in the range 3 to 100000.
⑤ Using the difference between the 2 delay counts which have been set in ③ and ④ above, two or more periods are measured.

Figure 2-14 shows a timing chart in which the measurement end delay count is assumed to be 3.

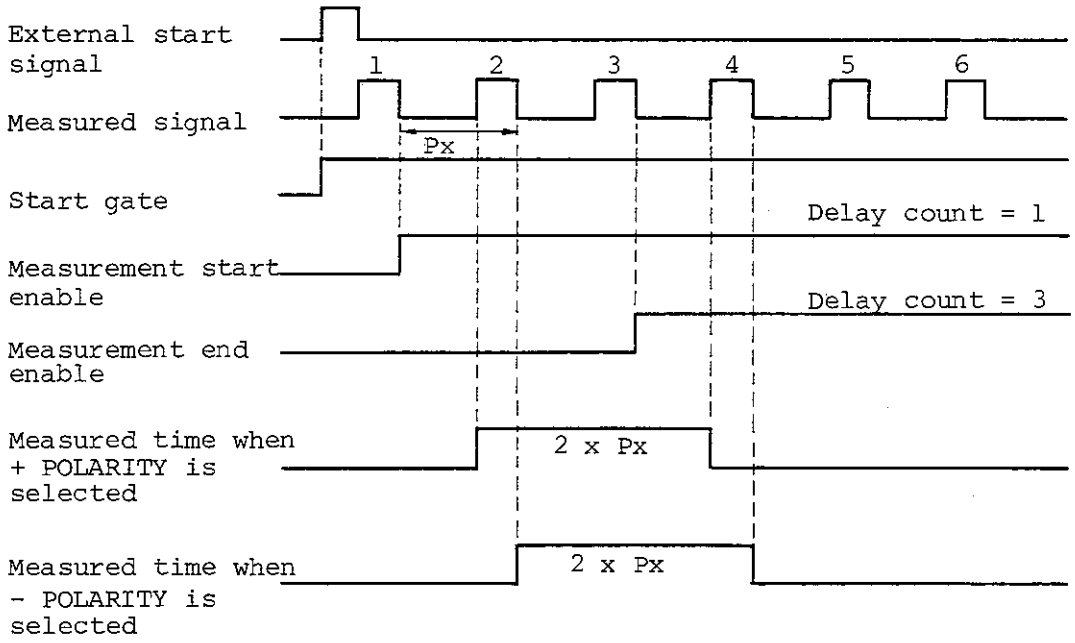


Figure 2-14 Measurement of Two or More Periods

2.16 MEASUREMENT OF COMPOUND PULSE WIDTH

If the settings shown below are made by referring to Section 2.13 "Pulse Width or Period Measurement by External Start, a compound pulse width which includes two or more periods (i.e. 1 to 99999 periods) can be measured. However, the measurable signal repetition rate is up to 20 MHz.

① Set FUNCTION to WIDTH.
② Set the DELAY switch on the rear panel to EVENT.
③ Set the measurement start delay event count to 1.
④ Set the measurement end delay event count to a value in the range 2 to 100000.
⑤ A pulse width whose length is extended two or more periods corresponding to the difference between the delay event counts in ③ and ④ is measured. (However, if - POLARITY is selected, the extended time is 1 period shorter.)

Figure 2-15 shows a timing chart in which the measurement end delay event count is assumed to be 3.

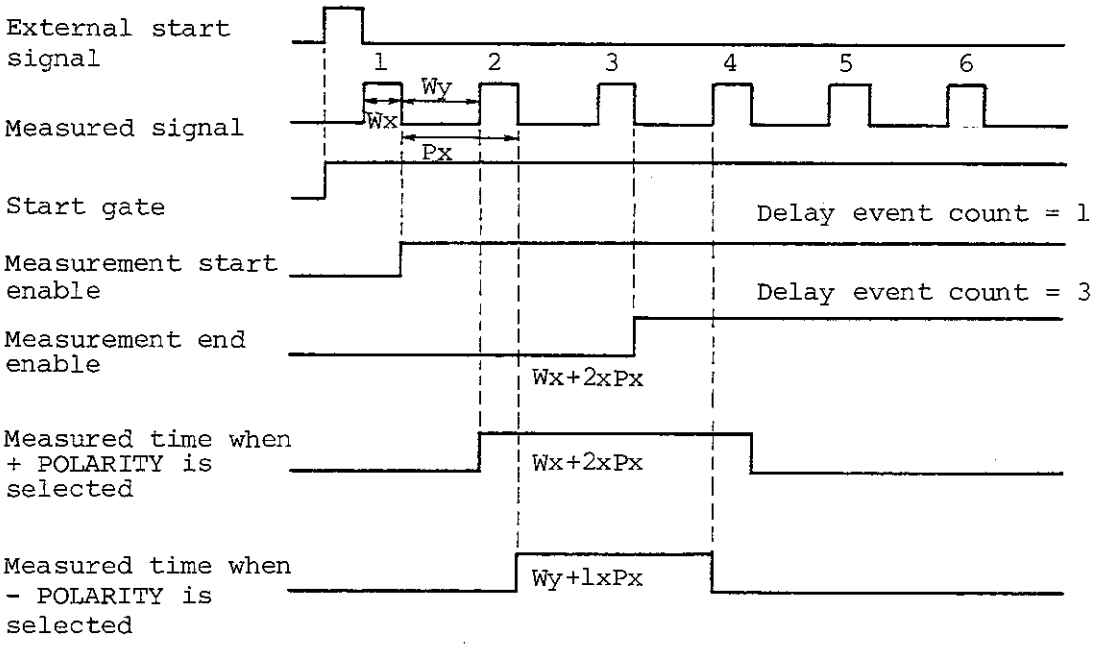


Figure 2-15 Measurement of Compound Pulse Width

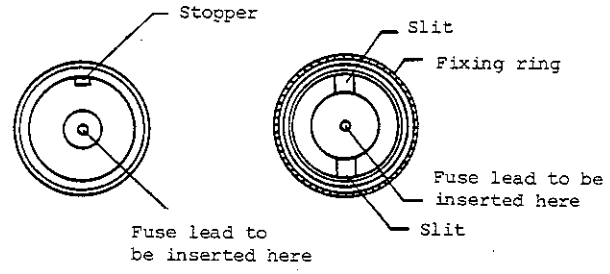
2.17 REPLACEMENT PROCEDURES OF INPUT FUSE

A protection fuse is housed in the INPUT connector of the counter. To replace the fuse, proceed in the following way.

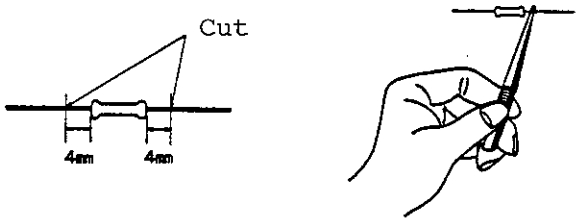
(1) Ratings of fuse

Parts Number	Ratings	Manufacturer
275.125	Axial leads 1/8A Subminiature picofuse	Littel Fuse Inc.

(2) Connector's external view



(3) Cutting of fuse



To cut a fuse, use sharp diagonal cutting pliers, etc. During the cutting work, hold the fuse by tweezers, as shown above, so that no pressure is applied onto the fuse.

(4) Replacement procedure

① Turn the fixing ring of the detachable part counterclockwise, and remove it.
② Remove the blown fuse.
③ Insert the fuse, which has been cut as described before in (3), into the central hole of the detachable part. (The insertion is done smoothly by turning the fuse or the detachable part.)
④ Insert the fuse into the fixed part so that the stopper of the fixed part meets with the slit of the detachable part.
⑤ Lightly turn the fixing ring of the detachable part clockwise.
⑥ Fasten the fixing ring firmly.

3. PRINCIPLES OF OPERATION

3.1 CONFIGURATION

The configuration of this counter is divided into 10 functional sections as shown below.

(1) Input section

(2) Measurement section

(3) Measurement control section

(4) Arithmetic operation control section

(5) Display section

(6) Operation section

(7) Time base generation section

(8) Clock division section

(9) Power supply section

(10) Interface section

Figure 3-1 shows simplified overall block diagram of this counter. The operation of each section is explained below.

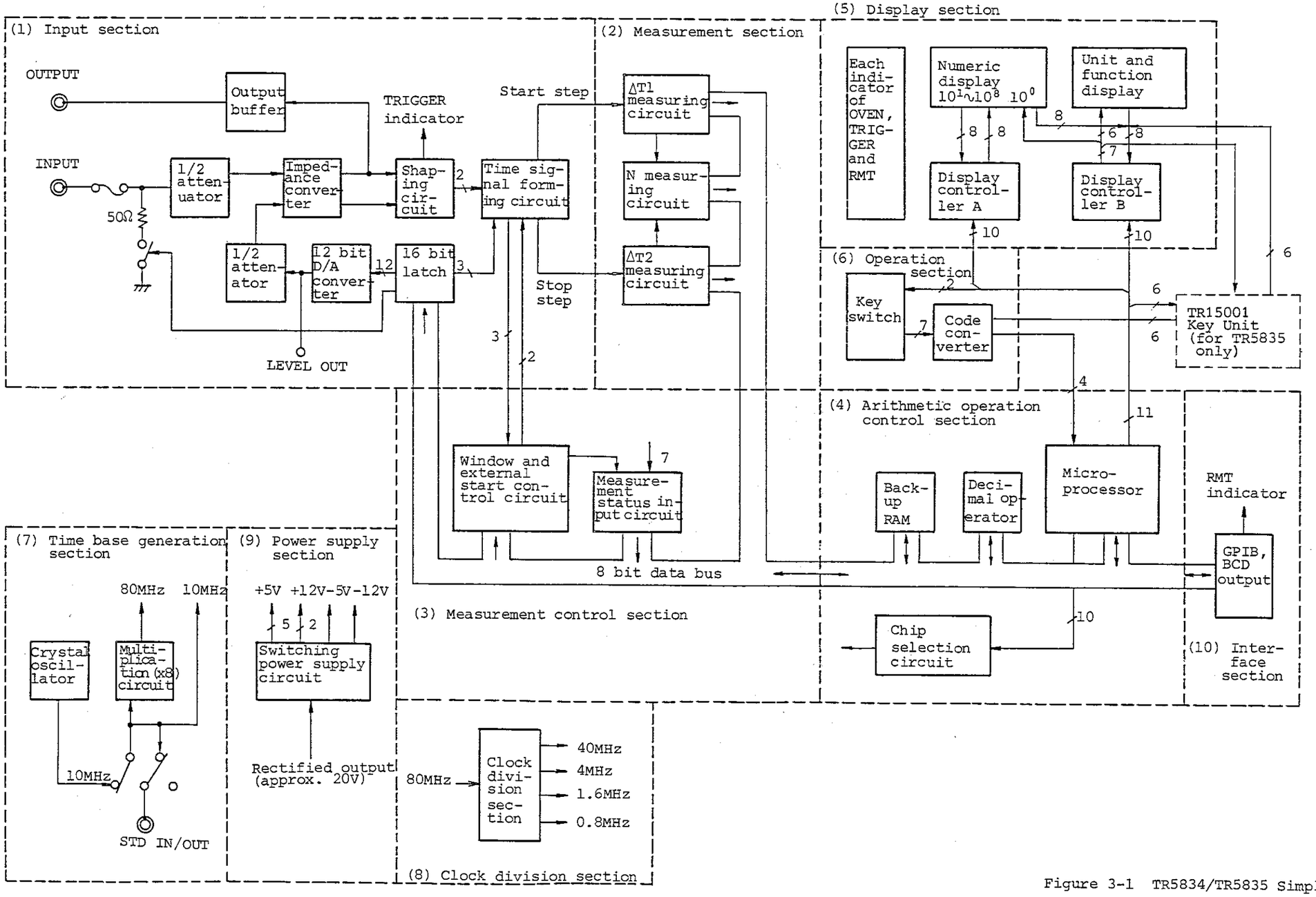


Figure 3-1 TR5834/TR5835 Simplified Block DIagram

3.2 OPERATION OF EACH SECTION

(1) Input section

The INPUT connector contains a protection fuse so that when the connector is used with a 50 Ω impedance, the terminating resistor is not destroyed by any high voltage input.

The measured signal, after passing through the protection fuse, enters into an attenuator and is attenuated to a half. The main purpose of inserting this attenuator is to decrease the input capacitance when viewed from the INPUT connector, and it realizes 35 pF which matches an oscilloscope probe.

After the attenuator, the input signal passes through an impedance converter which consists of a source follower and an emitter follower (2 stages), and enters into a shaping circuit. The output of the impedance converter also goes to an output buffer which consists of an emitter follower and, from there, is supplied to the OUTPUT connector as the monitor signal for adjusting the probe compensation. The source follower and the emitter follower of the impedance converter consist of a pair of FETs and a pair of transistors, respectively. The output of a D/A converter, which has been attenuated to half, is supplied to the impedance converter as another input.

The output of the D/A converter, which is in the range of -5 V to +5 V corresponding to the trigger level voltage, is also supplied to the LEVEL OUT terminal on the rear panel. The conversion is performed in 12 bits, where the minimum resolution is approx. 2.5 mV (in the case of TR5834, however, the resolution is 5 mV by regarding the smallest bit a margin). The reason why the trigger level is passed through the same path as that of other signals is that, due to temperature, the influence of level variations in the source follower and the emitter follower are lessened.

The shaping circuit includes a high speed comparator which provides ECL outputs and a feedback circuit to add hysteresis characteristics. Its outputs of positive and negative polarities enter into the time signal forming circuit, and are also used, after pulse width extension and level conversion to TTL, to drive the TRIGGER indicator.

Based on the shaping circuit outputs, the time signal forming circuit generates a start step signal and a stop step signal corresponding to the settings of FUNCTION and POLARITY. Figure 3-2 shows its timing chart. Time difference between the leading edges of these 2-step signals is measured with high precision in the measurement section (2).

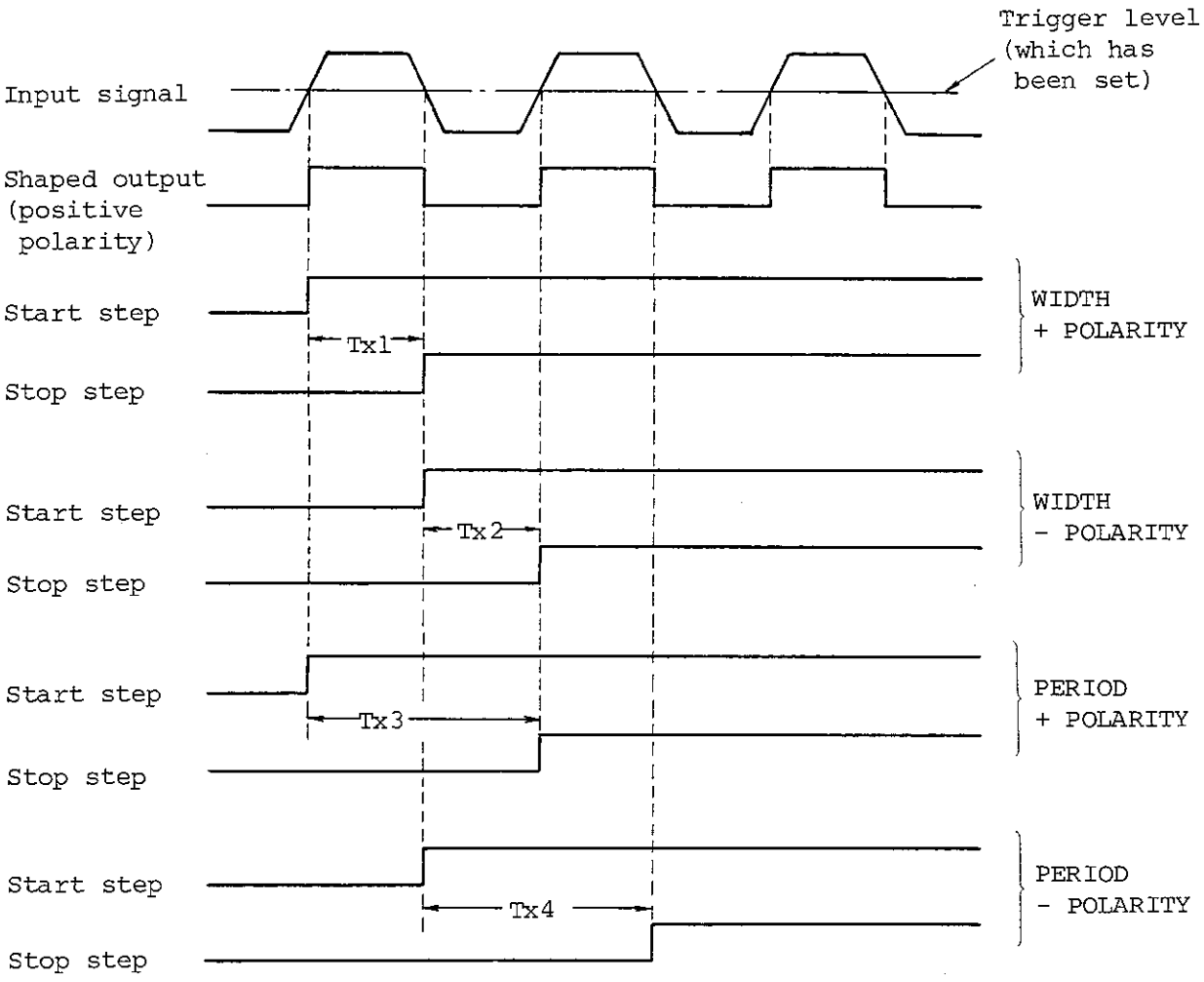


Figure 3-2 Generation of Start and Stop Step Signals

Each step signal is returned to the initialization status (low level) by the internal reset signal. In INT START (internal start) mode, the first signal which comes after the reset signal has ended is used to generate each step signal. In EXT START (external start) mode, however, after the reset signal has ended, the operation is in standby status for a predetermined time (until an external start signal is applied and a preset delay is passed).

(2) Measurement section

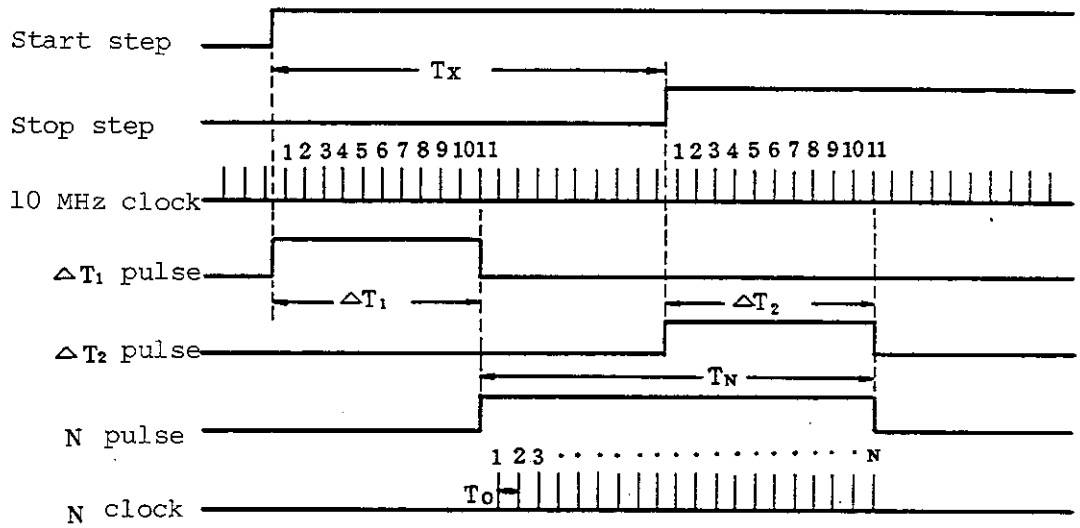


Figure 3-3 Generation of ΔT_1, ΔT_2 and N Pulse

When a start step signal and a stop step signal are sent from the input section, ΔT_1, ΔT_2 and N pulses are generated first. Figure 3-3 shows its timing chart. Time taken after the start step has come until 11-th clock appears is regarded as a ΔT_1 pulse, and time taken after the stop step has come until 11-th clock appears is regarded as a ΔT_2 pulse. The time difference between the end of the ΔT_1 pulse and the end of the ΔT_2 pulse gives an N pulse. Because the N pulse is synchronized with the 10 MHz clock (period T0 = 100 ns), its width can be measured by the number (N) of pulses passed through it. The timing relationships in Figure 3-3 gives the following equation:

$$T_X + \Delta T_2 = \Delta T_1 + T_N$$
$$T_X = T_N + \Delta T_1 - \Delta T_2$$
$$= N\,T_0 + \Delta T_1 - \Delta T_2 \quad \cdots\cdots\cdots \quad (3\text{-}1)$$

The 1st term on the right-hand side has a resolution of up to 100 ns, and better resolution is obtained by measuring ΔT_1 and ΔT_2 precisely. For that purpose, a 2-channel time expander is used to expand pulse width through the medium of analog quantity (voltage). Figure 3-4 shows the configuration of a time expander, and Figure 3-5 shows an operation timing chart.

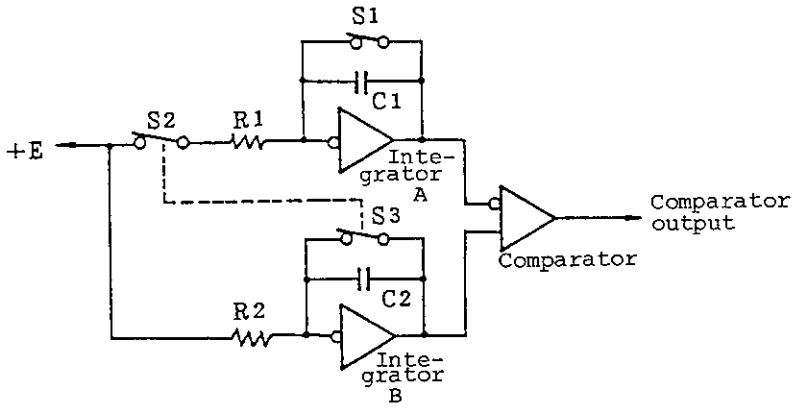


Figure 3-4 Configuration of Time Expander

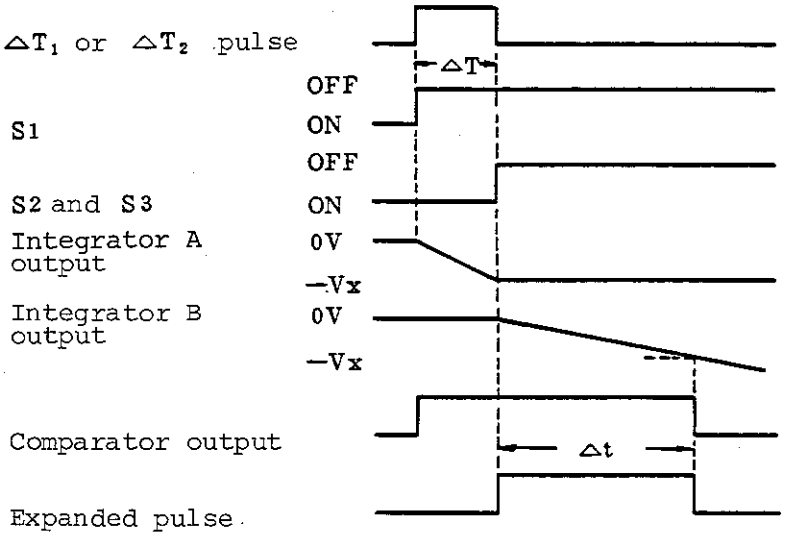


Figure 3-5 Operation of Time Expander

The expansion ratio by the expander itself is given as follows:

$$\text{Expansion ratio} = \frac{\Delta t}{\Delta T} = \frac{R2C2}{R1C1} \quad \cdots\cdots\cdots (3\text{-}2)$$

Because two expanders for ΔT_1 and ΔT_2 are independently used, normalization in relation to the reference of each of them becomes necessary. This counter performs the normalization in 2 stages, and Table 3-1 shows its contents.

Table 3-1 Normalization of Measurement by Expanders

Stage	Corresponding Measurement Mode	Clock Frequency to Count t	Normalization Method	Remarks
I	SHORT CYCLE	40 MHz	$\frac{\Delta t_1 - A_1}{\Delta t_2 - A_2}$	A_1, A_2: Expanded value for 1 μs
II	LONG CYCLE	80 MHz	$\frac{\Delta t_1 - A_1}{B_1 - A_1}$ $\frac{\Delta t_1 - A_1}{B_2 - A_2}$	B_1, B_2: Expanded value for 1.1 μs

The operation for normalization is performed for each measurement, but the reference values of A1, A2, B1 and B2 are obtained and updated during measurement rest periods.

(3) Measurment control section
This section includes a window circuit to realize a function of discrimination which is a special feature of this counter. Figures 3-6, 3-7, and 3-8 show the configuration, operation timing, and control procedure of the window circuit, respectively. Each of the preset type counters L and H consists of 5 stages. When a lower limit value ℓ and a higher limit value h of a discriminating range are designated through the operation section (6), the microprocessor in the arithmetic operation control section (4) prepares the following preset data:

$$\text{Preset data for counter L} = 10^5 - \frac{\ell}{T_0} \quad \ldots\ldots \quad (3\text{-}3)$$

$$\text{Preset data for counter H} = 10^5 - \frac{h}{T_0} \quad \ldots\ldots \quad (3\text{-}4)$$

where T_0 is the period of count clock, and either 12.5 ns (80 MHz) or 1.25 μs (0.8 MHz) can be selected. These values give the minimum resolution of discrimination.

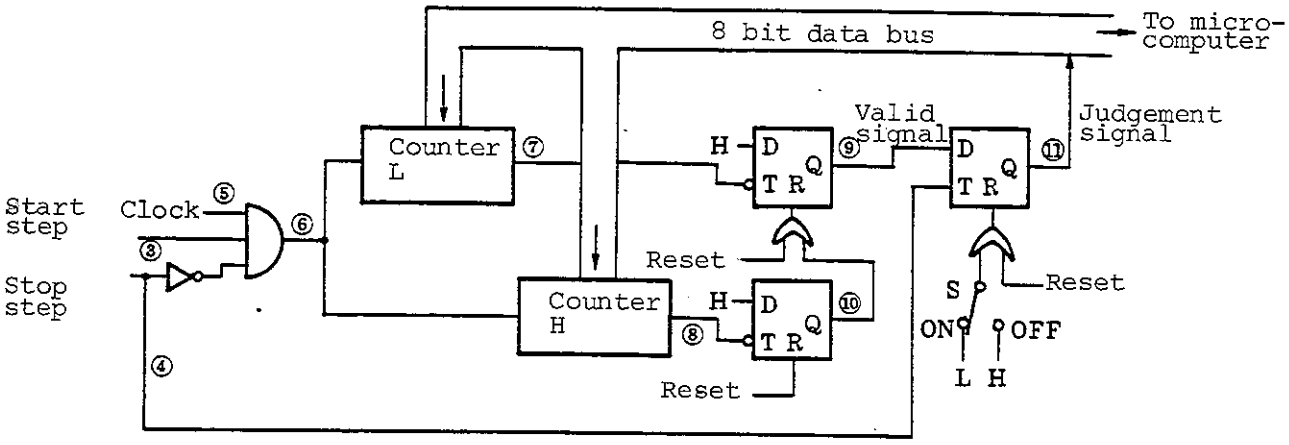


Figure 3-6 Configuration of Window circuit

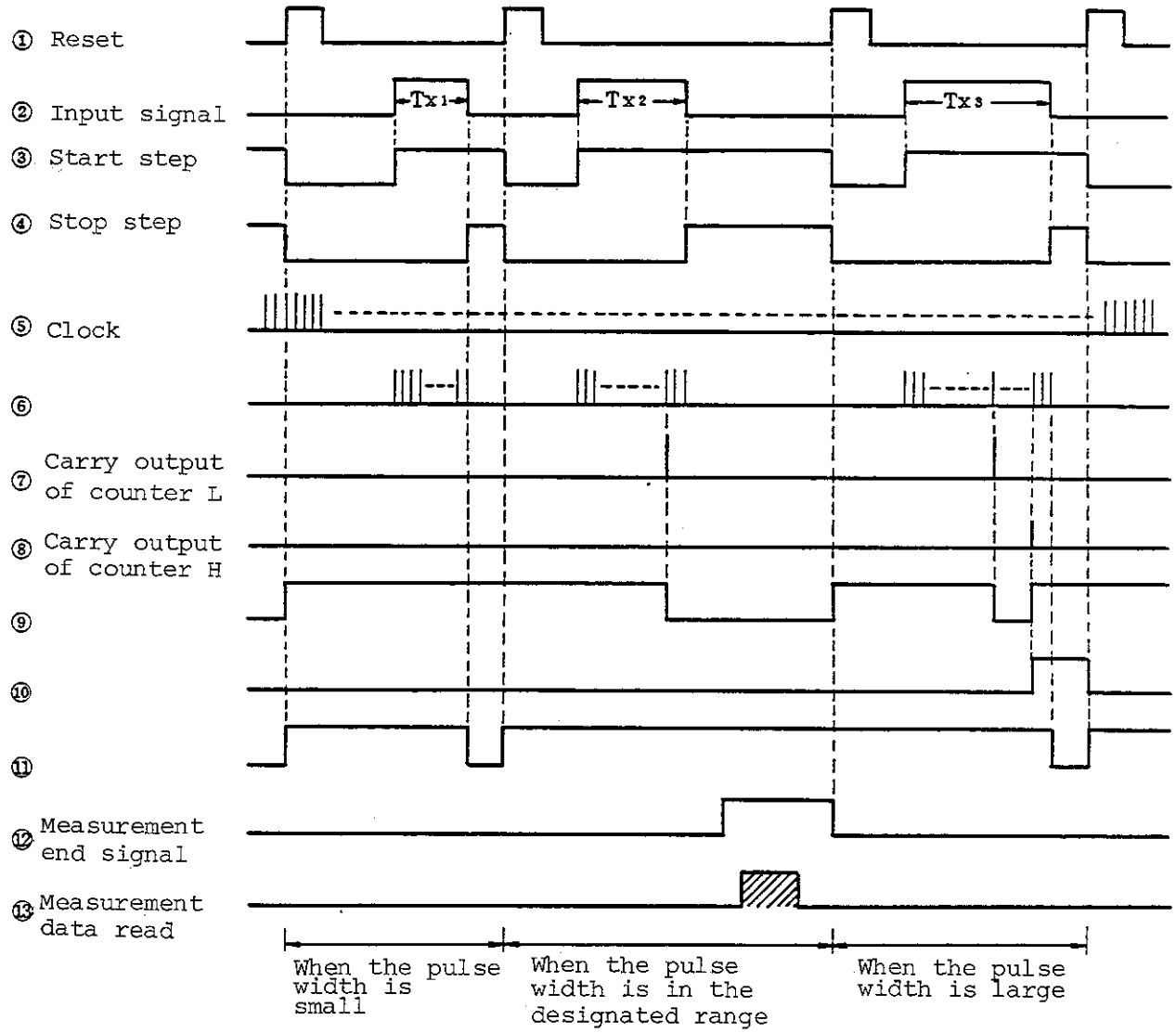


Figure 3-7 Operation Timing of Window Circuit

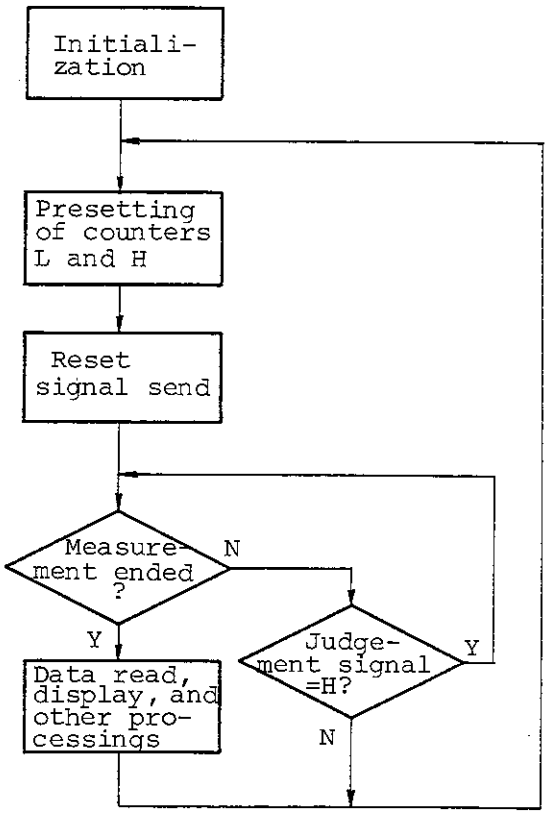


Figure 3-8 Control Procedure of Microcomputer

The point of discriminating operation is whether or not the valid signal (⑨ in Figures 3-6 and 3-7) is L when a stop step (④ in Figures 3-6 and 3-7) has occurred. If the valid signal is L, the measured value is regarded to be within the range but, if the valid signal is H, the measured value is deemed outside the range.
As shown in Figure 3-6, if the switch S is is set to H, the judgement signal always becomes H, and so this operation alone cancels the window function.
Figure 3-7 shows an operation timing chart of the window circuit in which, for example, pulse widths are measured when they are small, appropriate, and large in relation to the designated range. The measurement end signal (⑫ appears when a measurement operation at the measurement section has ended, about 250 μs after a stop step has occurred.

(4) Arithmetic operation control section
As the main controller, this section uses a 1 chip 8 bit microprocessor which has 32 I/O port lines. (For TR5835, a 16 bit board computer is used.) The main arithmetic operation control contents of this section are explained below.

① Self-diagnostics
When the power switch has been turned ON, ROM, RAM, etc. are checked, and lamps are tested. If any error is found in the former check, numerals or characters other than "8" are displayed during the lamp test.

② Preparation for measurement
Measurement conditions which have been set through the panel keys are decoded and sent to the related circuits. For 2 types of reference values, two expanders of ΔT_1 and ΔT_2 operate and then, measured values are preserved as normalization data.

③ Sequence control during measurement
After issuing a reset signal, the control is put in standby status waiting for the occurrence of a start step signal. When a start step has occurred and a measurement has started, a stop step signal is waited for. During this standby status, if the window judgement signal becomes L, the measurement returns to the beginning of operation.

④ Data processing
By using 3 types of measured values (N, Δt_1 and Δt_2) sent from the measurement section and the normalization data (A1, A2, B1 and B2), Tx is calculated.
When SAMPLE NUMBER is set to other than 1, the following 5 types of data are preserved:

$$A = Tx1 \quad \cdots\cdots\cdots (3\text{-}5)$$

$$B = MAX\ (Tx1, \ldots, Txi) \mid i = 1 \text{ to } k \quad \cdots\cdots\cdots (3\text{-}6)$$

$$C = MIN\ (Tx1, \ldots, Txi) \mid i = 1 \text{ to } k \quad \cdots\cdots\cdots (3\text{-}7)$$

$$D = \sum_{i=1}^{k} Txi \quad \cdots\cdots\cdots (3\text{-}8)$$

$$E = \sum_{i=1}^{k} (Txi - Tx1)^2 \quad \cdots\cdots\cdots (3\text{-}9)$$

After a designated number of measurements have ended, 5 types of statistical operation value (σ, RANGE, MAX, MIN and MEAN) are calculated using the results of (3-5), (3-6), (3-7), (3-8) and (3-9).

⑤ Key switch control
When a key operation has been done, the microprocessor reads the type of the key, changes settings accordingly, and starts a measurement under new conditons.

⑥ Data transfer to the display controllers A and B
8 higher digits of numerals and decimal point data are sent to the display controller A. The lowest digit numeral, decimal point data, and the unit and function display data are set to the display controller B.

⑦ Data transfer to interface accessory
when a GPIB or BCD output accessory unit is installed, measurement results are sent to them. If no accessory is present, no data are transferred.

⑧ Remote data read
When a GPIB accessory is installed and remote data are transferred from the external controller, the data are read and, depending on the contents, measurements are performed.

The decimal operator is used for executing the division of the LONG CYCLE normalization operation shown in Table 3-1. Its operation time is approx. 1.3 ms (12 digits) and the decimal operator is used twice for Δt_1 and Δt_2. (Because the TR5835 uses its board computer to do this operation, the decimal operator is omitted.) During SHORT CYCLE, the decimal operator is not used.

The backup RAM is a C-MOS type static RAM which stores the panel settings. When the counter is not connected to an AC power mains, this RAM is supplied current from the internal Ni-Cd battery. Each time key switches are operated on and panel settings change, the contents of this RAM are updated. Only when any error of the RAM or battery occurs or when the battery voltage has lowered due to a long term discharge, the counter's panel settings return to the predetermined initialization contents.

(5) Display section
The display section uses two LSI units (i.e. display controllers A and B). When display data have been sent, these LSI units store the data and directly drive LED units until new data come.

(6) Operation section
12 key switches which have conductive rubber contacts are used on the panel (and, internally, 1 key switch for manufacturing purpose).

(7) Reference time generation section
The multiplication circuit (x 8) consists of three stage tuned amplifier and the multiplication from 10 MHz to 80 MHz is thus realized by a simple circuit.

(8) Clock division section
In addition to 10 MHz and 80 MHz, this counter uses 7 types of clock signals: 40 MHz, 8 MHz, 4 MHz, 1.6 MHz, and 0.8 MHz. The last 5 clock signals are created by dividing 80 MHz signal (i.e. 1/2. 1/10, 1/20, 1/50, and 1/100).

(9) Power supply section
This section consists of a DC-DC type switching power supply circuit. On each output line, a series regulator is also used.

3.3 MEASUREMENT ACCURACY

For both measurements of WIDTH and PERIOD, the measurement accuracy is given as follows:

± 2 ns/1.5 ns $\pm$ (trigger error) $\pm$ (reference time accuracy) ... (3-10)

Reference time accuracy in the 3rd term is determined by the aging characteristic (5×10^{-8}/day, 1×10^{-7}/month, 2.5×10^{-7}/year) of the crystal oscillator used, but when the measurement time is 1 ms or less it scarcely affects the measurement accuracy. If the counter has been used without calibration for 4 years and is now used to measure 1 ms, for example, the worst error is as follows:

± 1 ms $\times 4 \times 2.5 \times 10^{-7} = \pm 1$ ns

However, when the measurement time is larger than 1 ms, the influence is larger. So if highly accurate measurements are required, calibrate the internal crystal oscillator periodically or use an external reference signal whose aging characteristic is good.

The 2nd term (i.e. trigger error) is an error factor which is most likely to affect the measurement accuracy. This is given as follows:

$$\text{Trigger error [Srms]} = \frac{1}{SR} (2.8 \times 10^{-4} \times 0.32 \times En) \quad \text{..... (3-11)}$$

where SR: Signal slew rate [v/s]
En: Noise voltage [Vrms]

The 1st term of (3-11) is created by the noise in the counter. So, even when the external noise En is zero, the trigger error cannot be zero. Note the fact that when the signal is a sine wave or a triangular wave, the trigger error becomes particularly dominant. Figure 3-9 shows the relationship between SR, amplitude, and frequency for sine wave signals. With the amplitude of 0.1 Vrms, Figure 3-9 gives SR values of 8.9×10^5 V/s, 8.9×10^2 V/s, and 0.89 V/s at 1 MHz, 1 kHz, and 1 Hz, respectively. So when En =1 mVrms, the trigger error at each frequency is given as follows:

1MHz: ±0.67 ns rms, 1 kHz: ±0.67 µs rms,
1Hz: ±0.67 ms rms

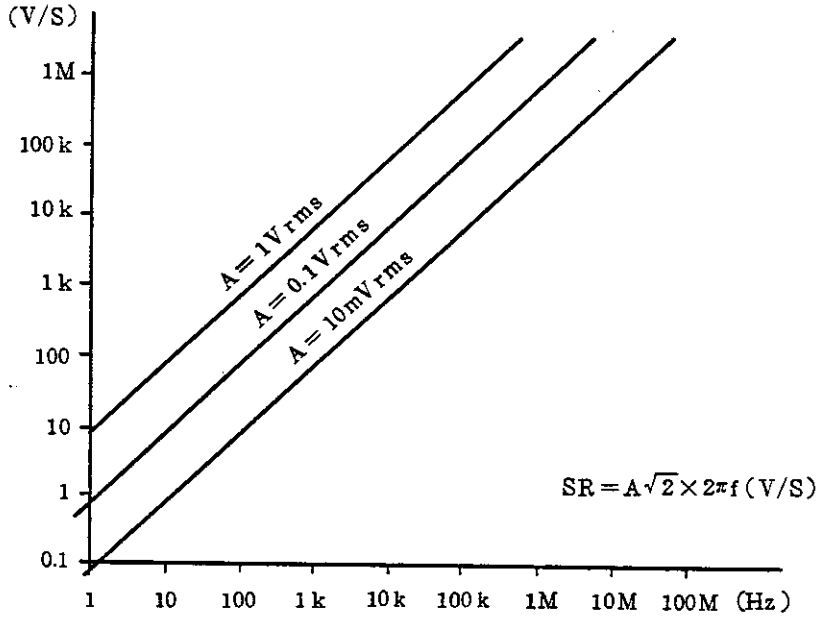


Figure 3-9 Relationship between Sine Wave's SR, Amplitude, and Frequency

4. CALIBRATION

4.1 INTRODUCTION

When the measurement time is mostly 1 ms or longer, the signal slew rate is large and the trigger error can be ignored, and the influence of the reference time error becomes large. In this case, to minimize the measurement error, it is necessary to calibrate (adjust) the oscillation frequency of the internal crystal oscillator which is used as the internal reference time of this counter.

4.2 CALIBRATION PROCEDURES

There are several calibration procedures. However, the simplest procedure which uses a frequency counter is explained here. The frequency counter must be of reciprocal type and have a measuring performance of 9 digits/s or more. (ADVANTEST counters of TR5824/TR5824A/TR5825/TR5825A/ TR5826/TR5826A or TR5830/TR5840 are most appropriate.) The reference time of the frequency counter must have an aging rate of 2×10^{-8}/day or more and be calibrated beforehand, and this frequency counter must be warmed up. The calibration procedure using a TR5824 as the frequency counter is explained below.

① Connect the output of the STD connector on the rear panel to INPUT B of TR5824.
② Set FUNCTION and GATE TIME of TR5824 to ⎍ (square wave measurement) of FREQ. B and < is, respectively.
③ Set the coupling mode and trigger level TR5824 to AC and PRESET, respectively.
④ Adjust the STD ADJ. control on the right-hand side of the top panel so that TR5824 displays 10.000000 MHz. (Now, the accuracy is calibrated to 1×10^{-7}.)
⑤ Set GATE TIME of TR5824 to <10s, and adjust the STD ADJ. control so that TR5824 displays 10.0000000 MHz. (Now, the accuracy is calibrated to 1×10^{-8}.)

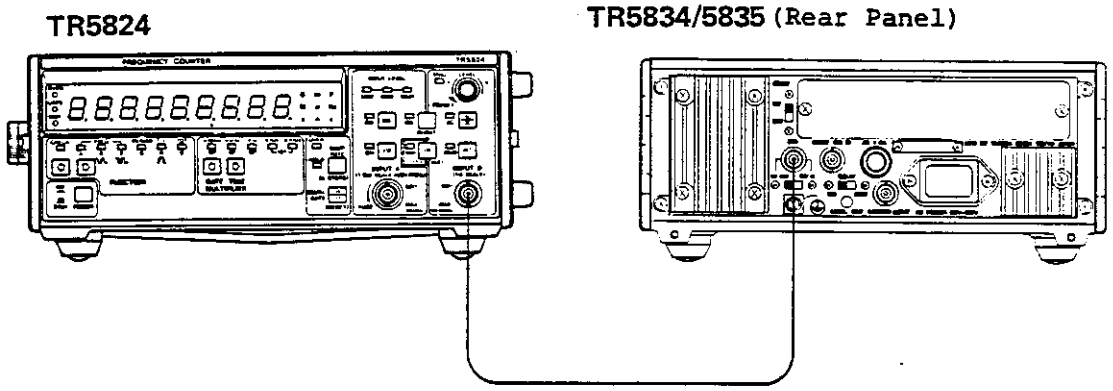


Figure 4-1 Calibration Using a Frequency Counter

4.3 CAUTIONS

Calibrate this counter once a year by using the STD ADJ. control on the top panel. If you fail the calibration by using the STD ADJ. control, please contact your nearest ADVATEST representative.

Reference

Specification of crystal oscillator (TCO-612L)

- Output frequency: 10 MHz.
- Aging characteristics : Based on the frequency obtained 24 hours after the power switch was turned ON: 5×10^{-8} or less/day, 1×10^{-7}or less/month, 2.5×10^{-7} or less/year
- Warm-up characteristics: Based on the frequency obtained 1 hour after the power switch was turned ON: $\pm 1 \times 10^{-7}$ or less/10 minutes, or based on the frequency obtained 24 hours after the power switch was turned ON: $\pm 2 \times 10^{-7}$ or less/10 minutes $\pm 1 \times 10^{-7}$ or less/30 minutes.
- Reproducibility : $\pm 5 \times 10^{-8}$ or less (Difference between the frequency 24 hours before the power-OFF and the frequency obtained 1 hour after the power-ON)
- Short-term stability : 5×10^{-9} or less/second
- Oscillation start time : Within 1 second after the power-ON
- Frequency variable range by ST ADJ. control: $\pm 5 \times 10^{-7}$ or more

MEMO

5. MAINTENANCE AND INSPECTION

5.1 INTRODUCTION

This chapter describes how to check the basic operations of this counter, gives cautions about the maintenance, and explains the troubleshooting. After this counter has been repaired because of faulty operation, make sure to perform calibration and operation check on the counter.

5.2 CAUTIONS ABOUT MAINTENANCE AND REPAIR

Before detaching the case of this counter for its maintenance, inspection or repair, set the POWER switch to STBY and disconnect the power supply cable.

While the power supply cable is connected, even if the POWER switch is set to STBY, the power supply transformer and the power supply section are powered, supplying power to the reference signal generator (crystal oscillator) and the backup RAM. An attempt to detach the case in this status is dangerous and can cause a new fault.

5.3 CAUTIONS ABOUT TRANSPORTATION

Because a crystral oscillator is used, handle this counter with care so that no excessive mechanical shock (5 G or more) is given to the counter.

5.4 PERFORMANCE CHECKS

This subsection explains how to check to see if the main functions of the counter are properly operating.

(1) Checks of ROM, RAM, etc.
Make sure that when the POWER switch is turned ON, the numeric LED display unit shows "8" at all digit positions.

(2) Operation checks of LED
When the POWER switch is turned ON, check for the followings:

① The numeric display unit shows "8" at all of its 9 digit positions, and the decimal point is turned ON for about 0.3 seconds at each digit position and moves from higher digit positions to lower digit positions.
② Except for the lamps of RMT and TRIGGER, all other LED lamps are turned ON.

(3) Output checks of the internal reference time signal

① Set the STD switch on the rear panel to INT OUT.
② Make sure, by using an oscilloscope, that a 10 MHz 1 V_{0}-p (approx.) internal reference time signal is being output through the STD connector (terminated by 50 Ω) on the rear panel.

(4) Input operation checks of the external reference time signal

① Set the STD switch on the rear panel to EXT IN.
② Apply an external reference time signal shown below into the STD connector on the rear panel.
Frequency: 10 MHz
Waveform : Square wave (duty ratio 1:1)
Level : 2 to 5 V_{0}-p (TTL level)
③ Set FUNCTION to TEST, and make sure that the operation of the counter is normal. (Refer to Section 2.4.)

(5) Operation checks of WIDTH

① Using the front panel keys, set the counter as follows:
FUNCTION ..... WIDTH
SAMPLE NUMBER 1
SAMPLE RATE ..... Approx. 160 ms.
LEVEL ..... +0.500V
WINDOW ..... OFF
IMPEDANCE ..... 50 Ω
② Set the rear panel switches of the counter as follows:
STD switch ..... INT OUT
START switch ..... INT
③ Using a supplied input cable, connect the STD connector on the rear panel to the INPUT connector on the front panel.
④ Make sure that the TRIGGER lamp is ON and the GATE lamp blinks.
⑤ Switch POLARITY, and make sure that the sum of two measured values obtained when POLARITY was + and - is approx. 100 ns.

(6) Operation checks of PERIOD

① Among the setting contents described in (5) above, change FUNCTION to PERIOD.
② Switch POLARITY, and make sure that the sum of two measured values obtained when POLARITY was + and - is in the range 100 ± 1 ns.

5.5 TROUBLESHOOTING

This section explains major possible faults and where they could occur.

(1) When the POWER switch is turned ON, numerals or characters other than "8" appear on the numeric display unit (9 digits).

- In the case of TR5834, the ROM (U13 on the MOTHER board (BLG-011634) is defective.
- In the case of TR5835, U3 or U2 on the CPU board (BGC-012870) is defective.

(2) Display errors

① All LED units on the front panel are not turned ON.
- Check the connection status (the plug side and the connector side) of the power supply cable.
- Check to see if the power supply fuse has blown.
- The power supply section of the counter is faulty.

② Except for OVEN lamp, all other LED lamps are not turned ON.
- The power supply circuit (POWER board (BLB-011926)) is faulty.
- The series regulator (U3 on the MOTHER board (BLG-011634)) for the display section is defective.

③ The 8 higher digits of the numeric display section show an error operation or do not light at all.
- The display circuit (U1 on the PANEL board (BLF-011925)) is faulty.

④ The numeric display unit lights but other LED units are not turned ON.
- The display circuit (U2 on the PANEL board (BLF-011925)) is faulty.

(3) Count operation errors

① The display stops at 0.0 and the GATE lamp does not blink.
- Check the setting position of the STD switch on the rear panel.
- Check each output of 10 MHz and 80 MHz of the multiplication circuit (MULTIPLIER board (BLB-011927)).

② The display shows random values.
- In the case of TR5834, the microprocessor (U12 on the MOTHER board (BLG-011634)) is defective.
- In the case of TR5835, U1 on the CPU board (BGC-012870) is defective.

③ The 2 lower digits of the display show random values.
- The ΔT_1 or ΔT_2 measuring circuit (EXPANDER board (BGC-011636 or, in the case of TR5835, BGC-012871)) is faulty.

5.6 DISASSEMBLING THE CASE

See Figures 5-1 and 5-2. After removing the 4 screws on the rear panel, the rear frame is detached and the mainframe of the counter may be extracted forward from the case. In the case of TR5835, first detach the key unit connector cover (having 1 screw).

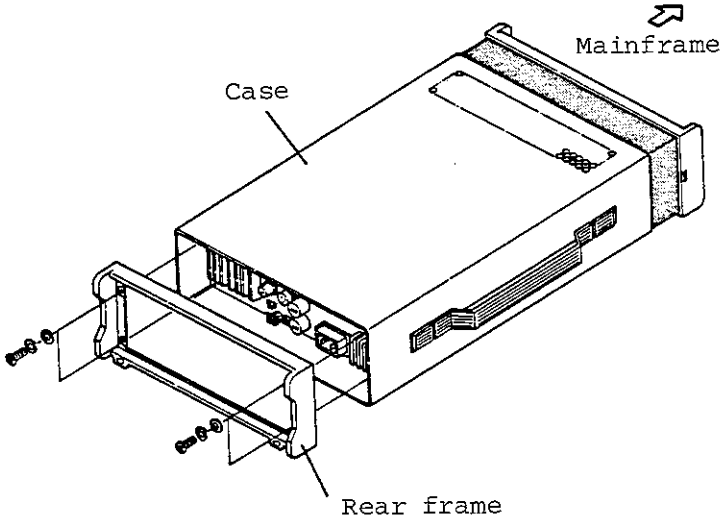


Figure 5-1 Disassembling the Case (TR5834)

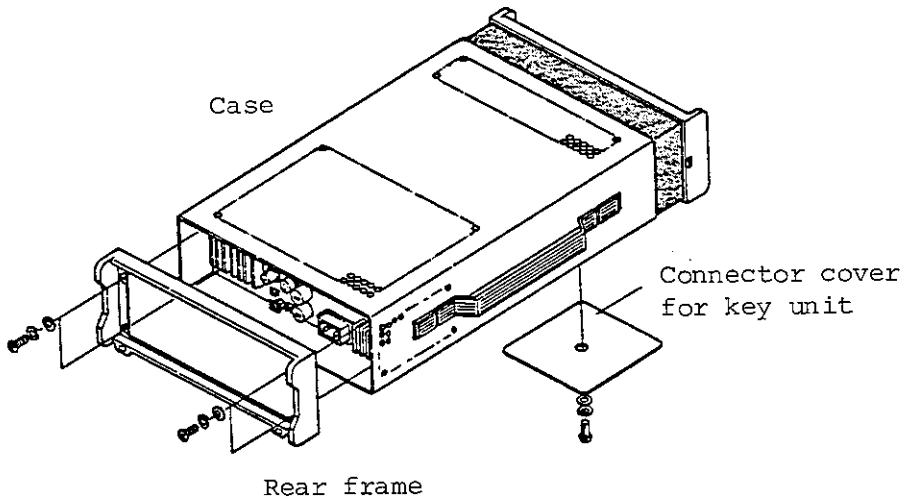


Figure 5-2 Disassembling the Case (TR5835)

MEMO

6. TR13006/TR13006A BCD OUTPUT UNIT

6.1 INTRODUCTION

TR13006 is a BCD output unit (with D/A output) which is used only with a TR5834 Pulse Jitter Counter. TR13006A is a BCD output unit (with D/A output) which can be used by either of TR5834/TR5835 Pulse Jitter Counters.

When this BCD output unit is installed, it is possible to print out (9 digits of) the display value of the counter by connecting a TR6198 Digital Recorder. If an analog recorder is connected, it is possible to record the change-over-time of a measured signal in which 4 lower digits of the display value is converted. In particular, if TR13006A is used together with TR5835 which is equipped with a TR15001 Key Unit, it is possible to obtain judgement results in comparison mode by a logic signal.

6.2 SPECIFICATIONS

(1) D/A output specifications

Output voltage	: 0 to +9.999V
Number of conversion digits	: 4 lower digits of the counter display value
Output connector	: BNC type connector
Conversion speed	: 20 ms or less (i.e. after the counter display but before the D/A output)
Conversion accuracy	: ±0.25% of f.s. (at 23 ± 5°C)
	: ±0.4% of f.s. (at 0 to 40°C)
Resolution	: Approx. 2.5 mV (12 bits)
Output impedance	: Approx. 100 Ω (to be connected with an instrument whose input impedance is 100 kΩ or more)
Output switching	: Possible. When the output is OFF, 0 V is output.

(2) BCD output specifications

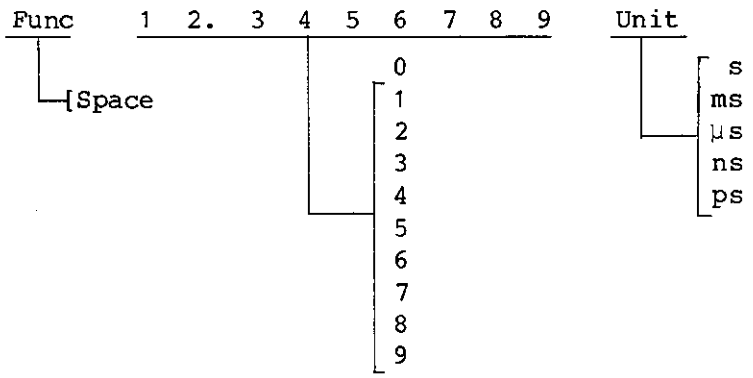
Data output format	: Digit parallel (8-4-2-1 code)
Data capacity	: 9 numeric digits, unit
Output level:	: TTL level
Fan-out	: 20 (LS type TTL)
Output connector	: Amphenol 57-40500 or its equivalent
Conversion speed	: 20 ms or less (i.e. after the counter display has been completed but before a data output command signal is issued)
Comparison judgement result	(TR13006A only)
	: Logic signal (and NG data may also be printed.)

(3) General specifications

Dimensions	: About 140 (W) x 30 (H) x 150 (D) mm
Ambient conditions to be used	
: Temperature	: 0 to +40°C
: Humidity	: 40 to 90%
Power consumption	: Approx. 3 w
Weight	: About 300 g

6.3 PRINT FORMAT (When TR6198 is Used)

When a TR6198 Digital Recorder is used, the print format is as follows:



When the TR5835 is using TR15001 and TR13006A in comparison mode, a logic signal is output under the "Func" of the above-mentioned print format as follows:

TR5835 display	Func		Output data (print data)
	2^1 (Pin 39)	2^0 (Pin 38)	
"PASS" or GO bar display	H	L	No output (no print)
NG data and trigger level, or NG display	L	H	NG data (4 higher digits) and trigger level (4 digits) are output. (For bar display, howerver, no data are output.)
Not in comparison mode	L	L	The measured data are

(1) Output signal level
TTL level, with positive polarity.

(2) BCD output code
Table 6-1 lists the BCD output code which is used for a TR6198 digital recorder.

Table 6-1 BCD Output Code

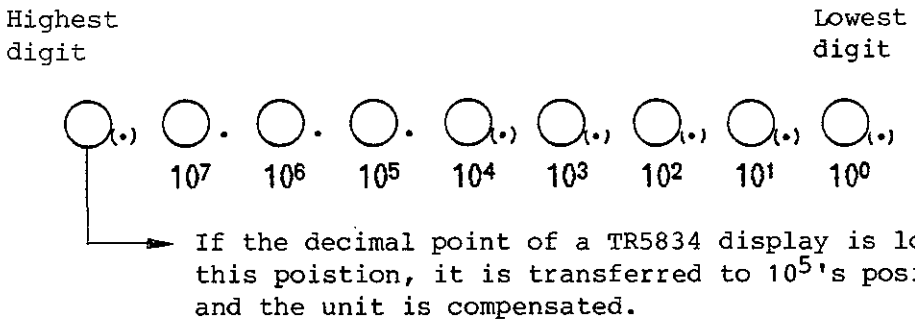
Input Code	Data	Function	Unit
8421			
0000	0		
0001	1		
0010	2		
0011	3	Space	
0100	4		
0101	5		
0110	6		μs
0111	7		ms
1000	8		
1001	9		
1010			ps
1011			s
1100			
1101			ns
1110			
1111	Space		

Note: No code other than those shown above is output.

(3) Decimal point code

Table 6-2 Decimal Point Code

Input Code 421	Decimal point position
000	(10^0)
001	(10^1)
010	(10^2)
011	(10^3)
100	(10^4)
101	(10^5)
110	(10^6)
111	(10^7)



Note: For decimal point, only 3 positions of 10^5, 10^6, 10^7 are used.

6.4 CONNECTOR PIN CONFIGURATION OF BCD OUTPUT

Table 6-3 Connector Pin Configuration

Pin Number	Signal Name		Pin Number	Signal Name	
1	GND (OV)		26	2^0	10^6 Data
2	2^0	10^0 Data	27	2^1	
3	2^1		28	2^2	
4	2^2		29	2^3	
5	2^3		30	2^0	10^7 Data
6	2^0	10^1 Data	31	2^1	
7	2^1		32	2^2	
8	2^2		33	2^3	
9	2^3		34	2^0	10^8 Data
10	2^0	10^2 Data	35	2^1	
11	2^1		36	2^2	
12	2^2		37	2^3	
13	2^3		38	2^0	Func
14	2^0	10^3 Data	39	2^1	
15	2^1		40	2^0	Unit
16	2^2		41	2^1	
17	2^3		42	2^2	
18	2^0	10^4 Data	43	2^3	
19	2^1		44	2^0	Decimal point
20	2^2		45	2^1	
21	2^3		46	2^2	
22	2^0	10^5 Data	47	Data output command signal	
23	2^1		48	External reset signal	
24	2^2		49	N.C.	
25	2^3		50	GND (OV)	

Notes: ● Pin 49 is not used.
● The external reset signal is an input signal, and other signals are all output signals.

(1) Data output command signal
Figure 6-1 gives a timing chart which shows the relationship between a data output command signal (called a print command signal when the TR6198 is used) and BCD output data.

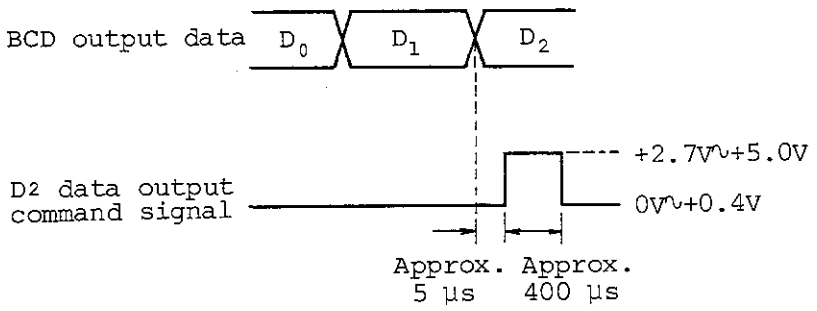


Figure 6-1 Timing Chart between BCD Output Data and Data Output Command Singal

(2) External reset signal
Figure 6-2 gives a timing chart which shows the relationship between an external reset signal (called a print end signal when the TR6198 is used) and a measurement start of the counter.

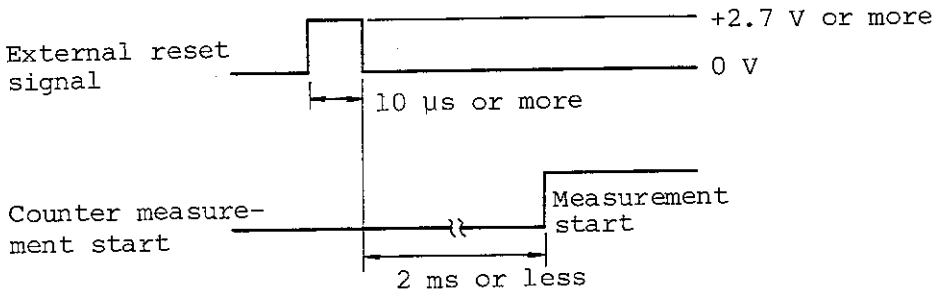


Figure 6-2 Timing Chart between External Reset Signal and Counter Measurement Start

6.4 CONNECTOR PIN CONFIGURATION OF BCD OUTPUT

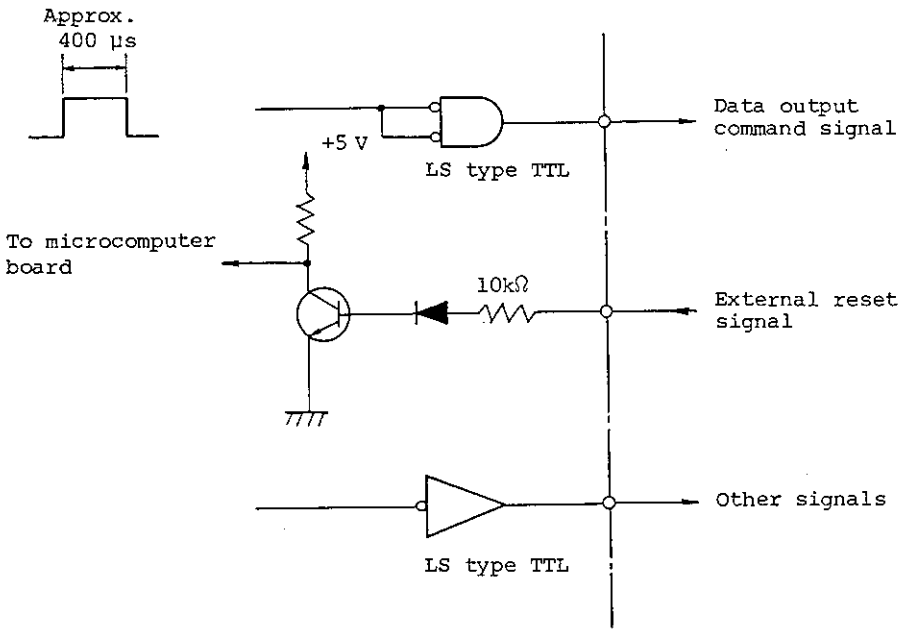


Figure 6-3 I/O Circuit

① Data output command signal (TTL level)
Pulse width: Approx. 400 µs, positive polarity
Logic "1" : V_{OH} = +2.7 to +5.0 V
Logic "0" : V_{OL} = 0 to 0.4 V

② External reset signal
Pulse width: 10 µs or more, positive polarity
Logic "1" : $V_{OH} \geqq +2.7$ V
Logic "0" : $V_{OL} \leqq +0.8$ V

③ Other signals (output signals)
Logic "1" : V_{OH} = +2.7 to +5.0 V
Logic "0" : V_{OL} = 0 to +0.4 V

6.5 EXPLANATION OF PANEL AND TOP COVER

(1) Expalanation of panel

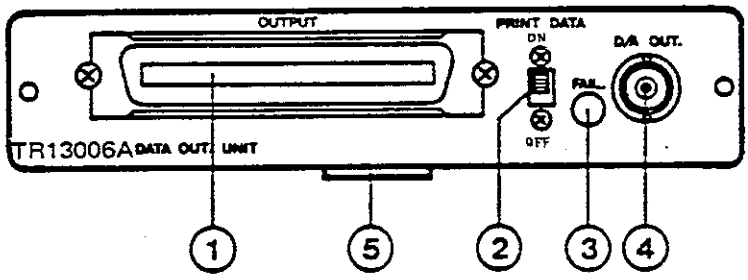


Figure 6-4 Explanation of Panel

① OUTPUT connector
This connector is used to output the BCD (8-4-2-1) code data of display values, and to input the data receive end signal. A 50-pin connector (Amphenol 57-40500 or its equivalent) is used. The I/O operation is performed at TTL level with positive logic.

② D/A output selection switch
If this switch is set to ON, an analog voltage output which corresponds to the 4 lower display digits of TR5834/TR5835 is obtained from the D/A OUT connector. If this switch is set to OFF, 0 V is always obtained from the D/A OUT connector.

③ FAIL lamp
The FAIL lamp lights if a fault has been detected during the self-diagnostics of ROM, RAM and ports, which is performed by the CPU after the POWER switch is turned ON. (After the power-ON, however, this lamp lights for about 2 seconds for testing purpose.) If the FAIL lamp continues to be ON, it means a fault status. Then, by referring to (1) in Section 6.9, confirm the fault status and contact your nearest ADVANTEST representative.

④ D/A OUT connector
This is a BNC type connector for outputting an analog voltage.

⑤ Knob for detaching the unit
This knob is used when this unit is detached. To detach the unit, remove the 2 screws on both ends of the unit panel and pull this knob.

(2) Explanation of top cover

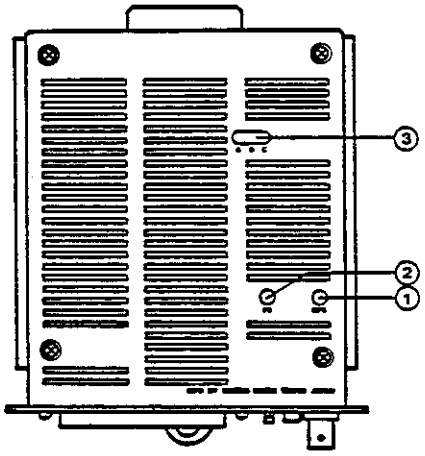


Figure 6-5 Explanation of Top Cover

① OFS
This adjuster is used to set an offset (+0.000 V). Refer to Section 6.9 "Maintenance".

② FS
This adjuster is used to set a full scale (+9.999 V). Refer to Section 6.9 "Maintenance".

③ A, B, and C lamps
When the FAIL lamp lights on the unit panel, these lamps explain the fault status which has been detected during the self-diagnostics, as shown in Table 6-4.

Table 6-4 Status During Self-Diagnostics

A	B	C	Fault Status
x	x	o	ROM fault
x	o	x	RAM fault
x	o	o	Port 0 fault
o	x	x	Port 1 fault
o	x	o	Port 4 fault
o	o	x	Port 5 fault

Note o: Lamp On
x: Lamp OFF

6.6 OPERATING PROCEDURES

This section describes preparations and cautions about the use of this unit, and explains how to mount this unit.

6.6.1 Cautions about Inspection, Storage, and Transportation

(1) Inspection
This unit was thoroughly tested at the factory before shipment. However, when you receive this unit, inspect for any visible damage, particularly, on the panel switches and terminals. If any damage is found or the operation is not satisfactory, please contact your nearest ADVANTEST representative.

(2) Storage
If this unit is not used for a long period, wrap it by a vinyl sheet or put it in a cardboard box, and store the unit away from dampness and direct sunlight.

(3) Cautions about transportation
When transporting this unit to another place, pack it up with the packaging material which was used when the unit was first delivered. If the material has been lost, however, pack up the unit in the following ways.

① Wrap the unit with a vinyl sheet, etc.
② Wrap the unit with cushioning material and put it in a cardboard box which is 5 mm or more thick.
③ Close and bind the cardboard box with packing strings.

6.6.2 General Cautions before Use

(1) Power supply
Before mounting this unit, first make sure that the POWER switch of the counter is set to STBY.

(2) Environment
Avoid the use of this unit in places where such undesirable environmental conditions as dust, direct sunlight and corrosive gas are observed. Use this unit in the ambient temperature range of 0 to 40°C and humidity range of 40 to 90%.

(3) Shock
Handle this unit with care so that no serious mechanical shock is given to it.

(4) When the TR6198 is used
when the PRINT INTERVAL switch of the TR6198 Digital Recorder is set to CONTINUOUS, set the sample rate time of the counter to approx. 1.6 s. A short sample rate time may cause printing errors. For others, refer to the TR6198 Instruction Manual.

6.6.3 Procedure of Mounting This Unit

① Set the POWER switch of the counter to STBY, and disconnect the power supply cable from the counter.

② Detach the blank panel from the rear panel of the counter. (See Figure 6-6.)

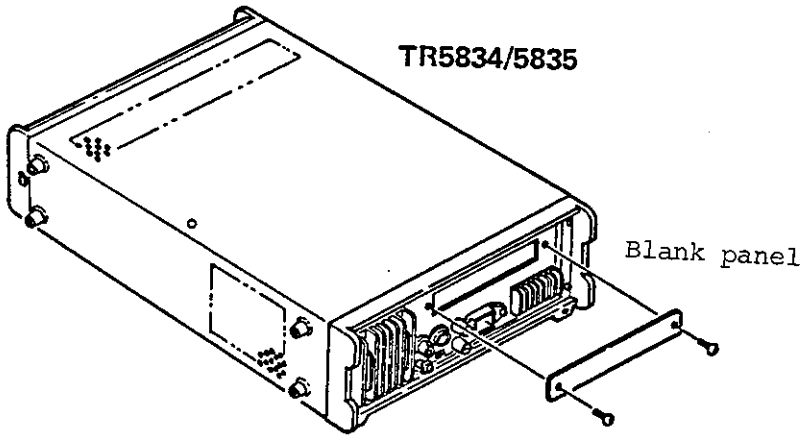


Figure 6-6 Detaching the Blank Panel

③ Mount this unit as shown in Figure 6-7

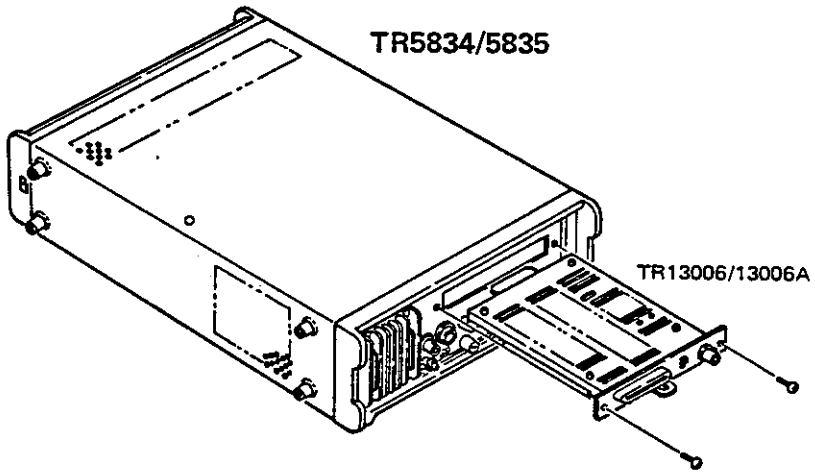


Figure 6-7 Mounting of the TR13006/13006A

④ Connect the power supply cable to the counter and set the POWER switch to ON. (Mounting completed)

6.7 PRINCIPLES OF OPERATION

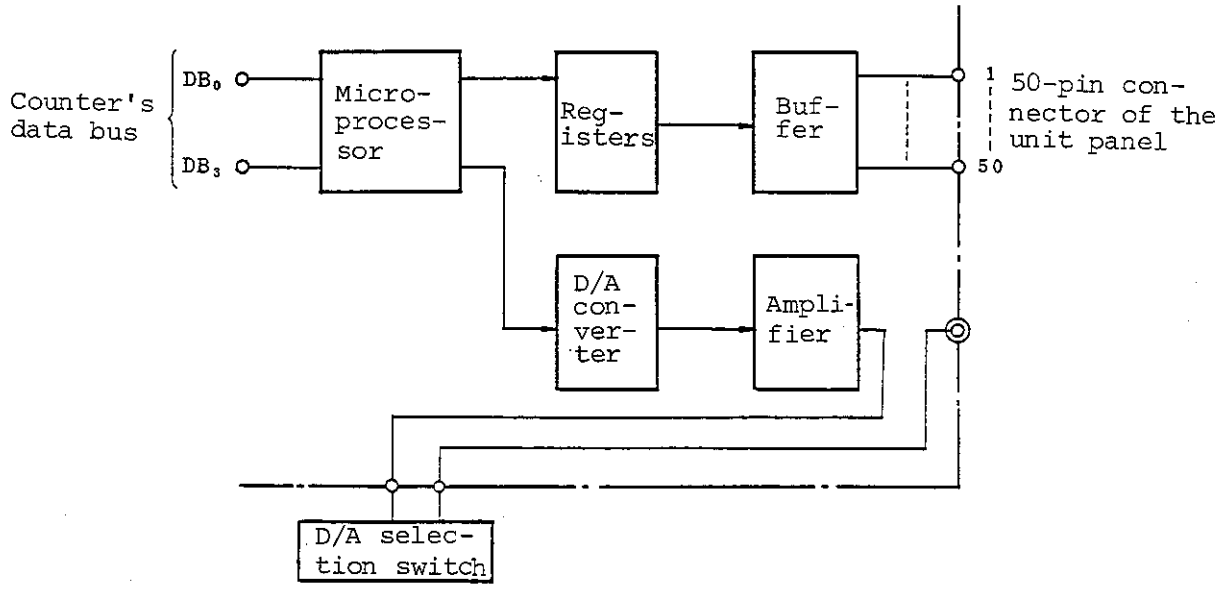


Figure 6-8 Simplified TR13006 Configuration Diagram

After the counter has displayed a numeric value, this unit receives the display value through the data bus and stores it in a register within the microprocessor. The microprocessor converts the received data into binary data and sends it to the digit parallel (8-4-2-1) and the D/A converter. When the data comes into the registers, it is converted into parallel data and output through the buffer to the OUTPUT connector.

The D/A converter changes the binary data, which has been sent from the microprocessor, into an analog value and outputs it through the amplifier to the D/A OUT connector. The D/A output selection switch turns ON or OFF the D/A converter output and, when it is OFF, the output voltage is 0 V.

6.8 PERFORMANCE CHECKS

6.8.1 Print Output

① Mount this unit into the counter and connect a TR6198 Digital Recorder. Before this, make sure that the POWER switches of the counter and the digital recorder are set to STBY and OFF respectively, and that the OVEN lamp of the counter is OFF. To connect the TR6198, use an ADVANTEST MM-02 cable.

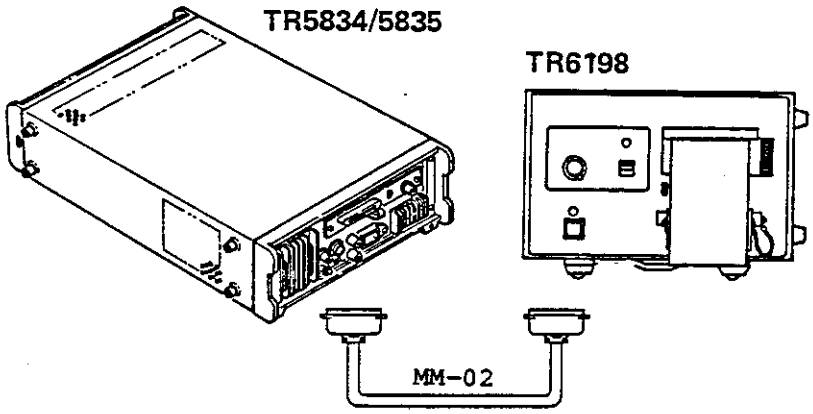


Figure 6-9 Connection with TR6198

② Set the POWER switches of the counter and TR6198 to ON.

③ Set the counter and TR6198 as follows:

- Counter
  FUNCTION : TEST
  SAMPLE NUMBER : 1
  SAMPLE RATE : Approx. 1.6 s (3rd step)
  (No other settings are required.)
- TR6198
  PRINT INTERVAL: CONTINUOUS
  Print condition setting switch
  COUNTER/D.V.M.: 1 (Set others to 0.)

④ Next, press the START switch of TR6198 and then the RESET key of the counter. If "99 ns to 101 ns" (or 99.0 ns to 101.0 ns for TR5835) is printed out, the operation is normal.

6.8.2 D/A Output

① In addition to the previous settings (③ of Section 6.8.1), set the D/A OUT selection switch of this unit to ON and connect a voltmeter (whose resolution is 1 mV and which can measure up to +10V) to the D/A OUT connector.

② Set the POWER switches of the counter and TR6198 to ON, and press the START switch of TR6198.

③ Then, if the readings of the voltmeter correspond to the display of the counter as shown below, the operation is normal.
(99 ns → 9.900 V, 101 ns → 1.010 V)
If the readings of the voltmeter fall outside the conversion accuracy, refer to "Adjustment of D/A OUT" in (2) of Section 6.9 and adjust the offset (+0.000 V) and the full scale (+9.999 V).

6.9 MAINTENANCE

(1) FAIL lamp

When the FAIL lamp lights, it shows that a fualt has been detected during the self-diagnostics. Confirm the fault status and contact your nearest ADVANTEST representative.

To confirm the fault status, remove the rear frame and the case by referring to Figures 6-10 and 6-11 and check the lamps A, B, and C together with Table 6-4.

(2) Adjustment of D/A OUT

In (3) of Section 6.8.2, if the readings of the voltmeter have fallen outside the conversion accuracy, perform the adjustments in the following procedures.

① Set the POWER switch of the counter to STBY, and disconnect the power supply cable.
② Remove the 4 screws on the rear panel of the counter as shown in Figure 6-10. (For TR5835, first detach the connector cover which is used to connect TR15001.)

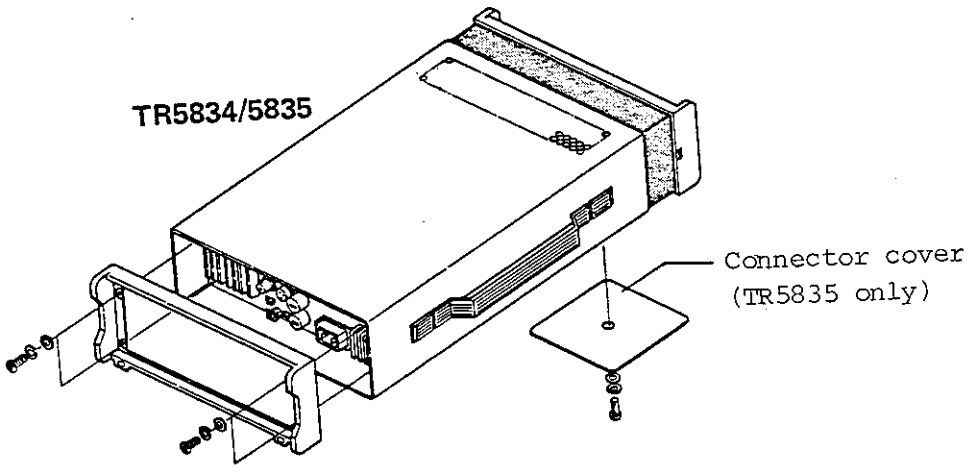


Figure 6-10 Disassembling the Screws and the Connector Cover

③ Detach the rear frame and the case as shown in Figure 6-11

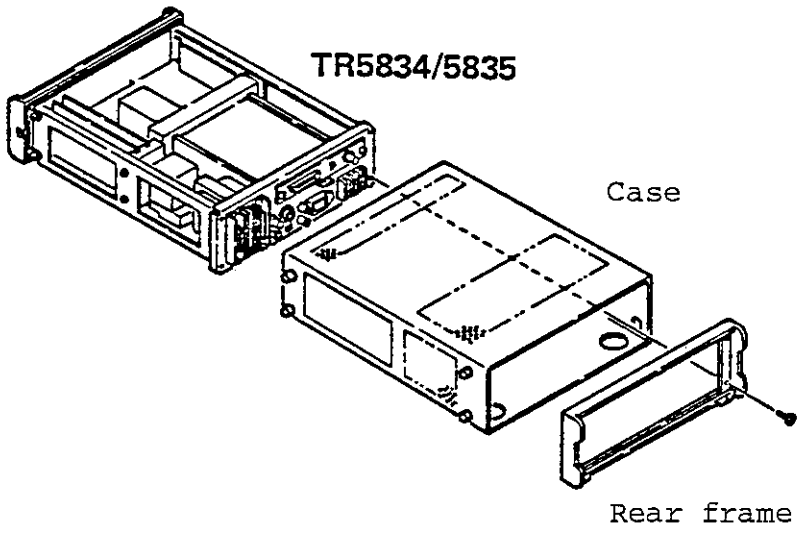


Figure 6-11 Disassembling the Rear Frame and the Case

④ Connect a voltmeter (whose resolution is 1 mV and which can measure up to +10 V) to the D/A OUT. connector of this unit.
⑤ Connect the power supply cable to the counter and set the POWER switch to ON.
⑥ Set 4 lower digits display of the counter to "0000", and adjust the OFS control on the top cover of this unit to +0.000 V. (Use a Phillips-head screwdriver to rotate the adjuster clockwise or counterclockwise).
⑦ Set 4 lower digits display of the counter to "9999", and adjust the FS control on the top cover of this unit to +9.999 V. (Use a Phillips-head screwdriver to rotate the adjuster clockwise or counterclockwise).
⑧ Repeat the adjustments in (6) and (7) again, and confirm the voltage values.
⑨ After all the adjustments have been completed, set the POWER switch to STBY, disconnect the power supply cable and the cable which has been connected to the D/A OUT connector, and attach the rear frame and the case in the order opposite to their previous detachment procedures.
Now, the D/A OUT adjustments have been completed.
Note that no part other than the adjusters should be touched by a screwdriver, etc. (particularly when the POWER switch is turned ON).
If you have failed to adjust within the conversion accuracy by following the above described procedure, please contact your nearest ADVANTEST representative.

7. TR13007/TR13007A GPIB ADAPTER

7.1 INTRODUCTION

TR13007 is a GPIB adapter which is used only with a TR5834 Pulse Jitter Counter. TR13007A is a GPIB adapter which can be used with either of TR5834/TR5835 Pulse Jitter Counter. If these adapters are used, TR5834/TR5835 Pulse Jitter Counter can be connected to IEEE standard 488-1978 instrumentation bus GPIB.

If this adapter is installed, it is possible to perform the remote control of all key switches on the front panel of the counter. In particular, if TR13007A is used together with TR5835 which is equipped with a TR15001 Key Unit, the remote setting of extended functions are also enabled.

And, by connecting an analog recorder, it is possible to record the change-over-time of a measured signal in which 4 lower digits display of the counter are converted.

7.2 OUTLINE OF GPIB

GPIB is an interface system which enables connection of a measuring instrument with a controller and other peripheral equipment by a simple cable (bus lines).

GPIB is simpler and more flexible to use compared with conventional interface methods, and has electrical, mechanical and functional compatibility with the products of other manufacturers. This enables construction from a simple system to a highly functional automatic measuring instrument system by using a single bus cable.

In a GPIB system, it is necessary to set an address for each of the devices which are connected to the bus lines. These devices can take one or more roles of controller, talker and listener. During the system operation, only one talker can send data to the bus lines and two or more listeners can receive the data. By designating the addresses of a talker and a listener, the controller transfers data from the talker to the listener. The controller himself (as talker) may set measuring conditons, to the listener.

For transferring data between the devices, 8 data lines of a bit parallel and byte serial form are used. This asynchronous and bidirectional data transmission system enables free mixing of high speed devices and low speed devices when connecting them.

Among data (messages) exchanged between the devices are measurement data, measurement conditions, and various commands which use ASCII code. In addition to the above-mentioned 8 data lines, GPIB provides 3 handshake lines which control asynchronous data exchanges between the devices and 5 control lines which control information flow on the bus.

- The handshake lines include the following signals.
  - DAV (data valid) : This signal shows that data lines have a valid byte of data.
  - NRFD (not ready for data) : This signal shows that the listening devices are not ready to accept further data.
  - NDAC (not data accepted) : This signal shows that the listening devices have not completely accepted the present byte of data.

- The control lines include the following signals.

ATN (attention)	: This signal shows whether signals on the data lines are an address, a command or other information.
IFC (interface clear)	: This signal clears the interface.
EOI (end of identity)	: This signal is used at the end of an information transfer.
SRQ (service request)	: This signal is used by any device to request the controller for a service.
REN (remote enable)	: This signal is used to remote-control a device for which the remote programming is possible.

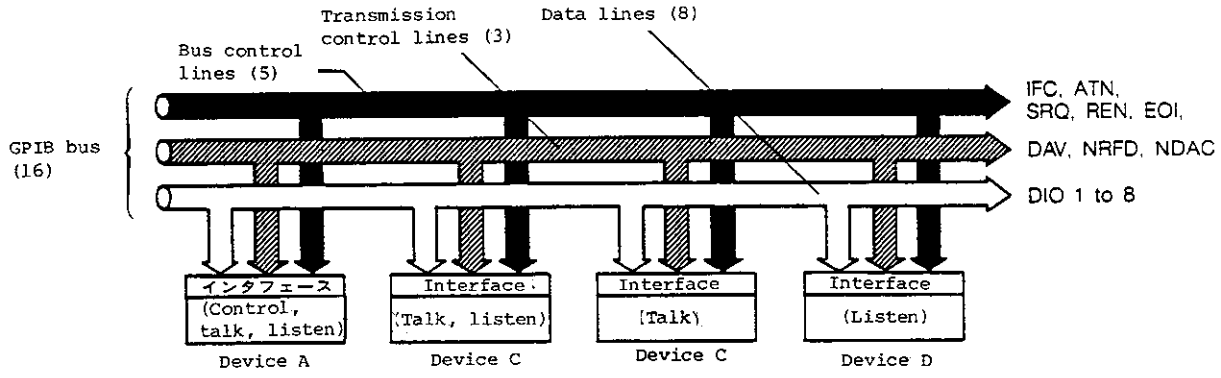


Figure 7-1 Outline of GPIB

7.3 SPECIFICATIONS

7.3.1 GPIB Specifications

Standards : IEEE standards 488-1978
Used code : ASCII code
Logic level : Logic 0 ("High" status) +2.4 V or more
Logic 1 ("Low" status) +0.4 V or less
Termination of signal lines: 16 bus lines are terminated as shown below

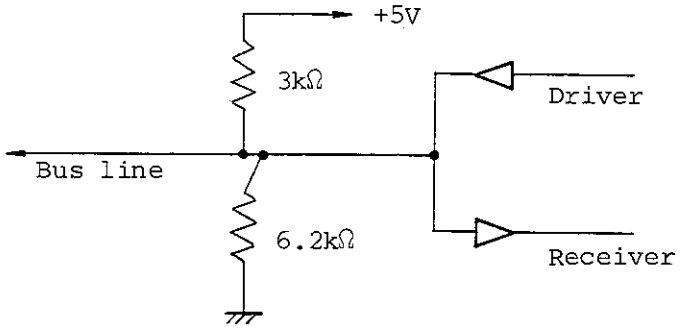


Figure 7-2 Termination of Signal Lines

Driver specification : Open collector type.
"Low" status output voltage:
+0.4 V or less, 48 mA.
"HIgh" status output voltage:
+2.4 V or more, -5.2 mA.
Receiver specification: +0.6 V or less as "LOW" status
+2.0 V or more as "HIGH" status
Bus cable length : Total bus cable length is up to (No. of devices connected to the bus) x 2 m, but not exceeding 20 m.
Address designation : The address selection switch on the rear panel is used to arbitrarily set from among 31 different talk addresses and listen addresses. TALK ONLY mode may also be designated.
Connector : 24 pin GPIB connector
57-20240-D35 (Amphenol or its equivalent)

7.3.2 Interface Functions

Table 7-1 lists the interface functions.

Table 7-1 Interface Functions

Code	Function and Explanation
SH1	Source handshake capability
AH1	Acceptor handshake capability
T5	Basic talker capability, serial pool capability, talk only mode capability, unaddressed to talk if addressed to listen.
L4	Basic listener capability, unaddressed to listen if addressed to talk
SR1	Service request capability
RL1	Remote capability
PP0	The parallel poll capability is not available.
DC1	Device clear capability (SDC command and DCL command can be used).
DT1	Device trigger capability (GET command can be used).
C0	The controller capability is not available.
E1	Open collector drivers are used.

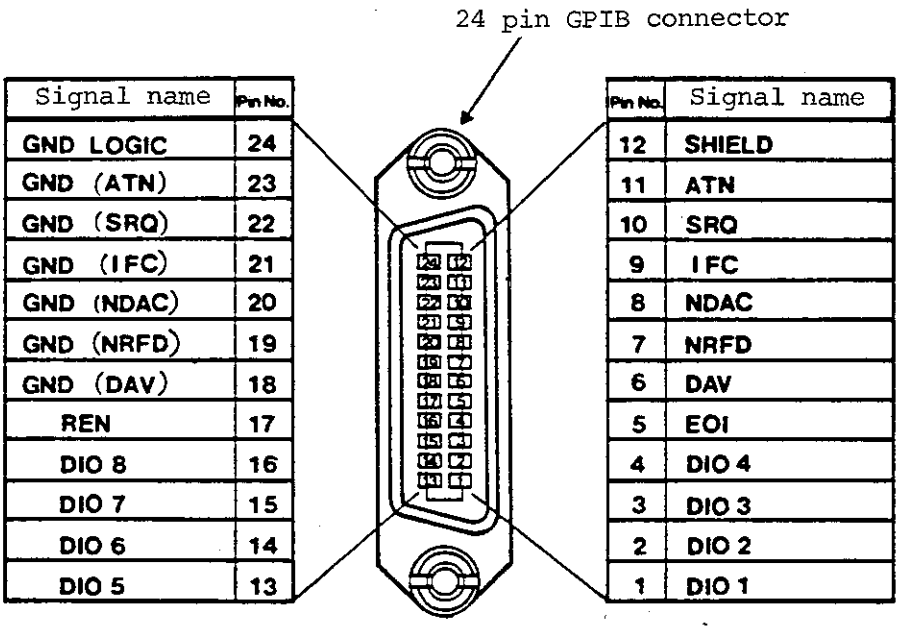


Figure 7-3 GPIB Connector Pin Configuration

7.3.3 D/A OUT Specifications

Output voltage	: 0 to +9.999 V
No. of conversion digits	: 4 lower digits of counter display values
Output connector	: BNC type connector
Conversion spped	: 20 ms or less
Conversion accuracy	: ±0.25% of f.s. (at 23 ± 5°C) ±0.4% of f.s. (at 0 to 40°C)
Resolution	: Approx. 2.5 mV (12 bits).
Output impedance	: Approx. 100 Ω (to be connected with a device whose input impedance is 100 kΩ or more)

7.3.4 General Specifications

Dimensions	: About 140 (W) x 30 (H) x 150 (D) mm
Ambient conditions to be used	: Temperature: 0 to +40°C Humidity : 40 to 90%
Power consumption	: Approx. 3 W (the power is supplied from the counter)
Weight	: About 300 g

7.4 DATA FORMATS

7.4.1 Talker Format (Data Output Format)

Data are sent in the following general format:

ASCII FORMAT

HH	S	D_0	$.D_1$	D_2	D_3	D_4	D_5	D_6	D_7	D_8	ESD_9	D_{10}	CR^{LF}_{EOI}
(1)	(2)	(3)									(4)		(5)

(1) Header part

HH

Unit ..... {"S␣": This shows that the unit of the output data is "Sec.".
"␣␣": This shows that the output data has no unit.

Note: If the HEADER of the address switch on the adapter's panel is set to OFF, 2 characters in the header part always become "␣␣" (space code).

(2) Data sign
"␣" (space for + (plus)
"-" for - (minus)

(3) Data
Data (9 digits) + decimal point (1 digit)
The position of the decimal point is fixed to the 2nd digit from the highest digit position.

(4) Exponent part sign
E + 09 ~ E - 15

(5) Data delimiter
CR/LF·EOI
As the data delimiter, CR is output as shown above and, then, LF is output together with EOI as valid signals.

7.4.2 Listener Format (Program Code)

(1) Measurement start command
A program code E can order the start of a measurement. A GET command can similarly order the start of a measurement.

(2) SRQ send modes
By using program codes S0 and S1, SRQ (service request) send modes are designated as shown below.
S0 mode: SRQ is sent in this mode. If, at the end of a measurement, the counter is addressed to talk, the counter sends data as they are but does not send SRQ. If the counter is not addressed to talk, it sends SRQ.
S1 mode: SRQ is not sent in this mode.

Table 7-2 shows the counter's status change which is caused by individual commands.

Table 7-2 Instrument Status Change by Commands

Command	Talker (with lamp)	Listener (with lamp)	SRQ (with lamp)	Status	Send Data	Remote setting value
POWER ON	Clear	Clear	Clear	Clear	Clear	Initialization
IFC	Clear	Clear				
DCL, SDC or C			Clear	Clear	Clear	Initialization
Get or E				To clear the bit which shows that send data exists	Clear	
Addressing to talk for the counter	Set	Clear				
Unaddressing to talk	Clear					
Addressing to listen for the counter	Clear	Set				
Unaddressing to listen		Clear				
Serial polling			Clear			

Note: Each slashed (/) column shows that the previous status does not change.

DCL: Device Clear
SDC: Selected Device Clear
GET: Group Execute Trigger

(3) Settings of functions, measurement ranges, etc.
Each setting code is shown below.

a. Operation contents setting of statistical processings (STATISTICS)

Code	Statistical operation
T0	σ Standard deviation
T1	RANGE (Maximum value - minimum value)
T2	MIN (Minimum value)
T3	MAX (Maximum value)
T4	MEAN (Mean value)

b. Setting of function (FUNCTION)

Code	Function
F0	WIDTH
F1	PERIOD
F2	TEST

c. Setting of sample number (SAMPLE NUMBER)

Code	Sample Number
N0	1
N1	200
N2	800
N3	VARIABLE

- Setting of sample rate sample number (in steps of 1)

Code	Variable sample number
NV dddd	10 - 10000

d. Setting of sample rate (SAMPLE RATE)

Code	Sample Rate
S2	FAST (approx. 10 ms)
S3	MID (approx. 160 ms)
S4	SLOW (approx. 1.3 s)
S5	HOLD (Infinite)

e. Setting of polarity (POLARITY)

Code	Polarity
K0	+ POLARITY (Positive polarity)
K1	- POLARITY (Negative polarity)

f. Setting of input impedance (IMPEDANCE)

Code	Input impedance
I0	1 MΩ//35 pF
I1	50 Ω

g. Setting of measurement speed (CYCLE RATE)

Code	Measurement speed
Y0	LONG CYCLE
Y1	SHORT CYCLE

h. Setting of trigger level (LEVEL)

Code	Setting of Trigger Level
L0	Preset (OV)
L1	VARIABLE

- Setting of level variable constant (unit: mV, step: 5)

Code	Level variable constant
LV ±dddd	-5000 - +5000

i. Setting of window (WINDOW)

① ON/OFF of window function

Code	Input impedance
W0	WINDOW OFF
W1	WINDOW ON

② Setting of window range
Depending on the setting position of the DELAY switch on the counter's rear panel, 2 types of ranges are available as follows:
If DELAY switch is set to TIME ..... (a)
If DELAY switch is set to EVENT .... (b)

Code	Constant's setting range	Unit
WL ddddddddd (Lower limit value)	125 - 12500000 (Up to 8 digits, in steps of 125	(a) 0.1 ns (b) 10 ns
WH ddddddddd (Higher limit value)	125 - 12500000 (Up to 8 digits, in steps of 125	(a) 0.1 ns (b) 10 ns
Other setting conditions	Lower limit value < Higher limit value	

j. Setting of delay
Delay which is described here is effective only in external start mode (when the START switch on the counter's rear panel is set to EXT). If an attempt is made to set delay in internal start mode (when the START switch on the counter's rear panel is set to INT), note the fact that event count delay will not cause any trouble but time delay will be regarded as a window range. However, if the START switch is set to EXT even after the delay setting, there will not be any trouble.

① Setting of time delay

Code	Constant's setting range	Unit	Step
WL ddddddd (Time delay for measurement start)	125 - 12500000	0.1 ns	125
WH ddddddd (Time delay for measurement end)	125 - 12500000	0.1 ns	125

When measurements are performed with this setting content, set the DELAY switch on the counter's rear panel to TIME.

② Setting of event count delay

Code	Constant's setting range	Step
XL dddddd (Event count delay for measurement start)	1 - 100000	1
XH dddddd (Event count delay for measurement end)	1 - 100000	1

k. SRQ setting code

Code	Function
S0	SRQ is sent
S1	SRQ is not sent

l. Other codes

Code	Function
E	Trigger (the same as GET)
C	Clear (the same as DCL, SDC)

To start a measurement, the used devices are initialized.
GET ..... Measurement start
SDC, DCL } ..... Initialization of devices

m. Input delimiter
The input delimiter is LF or EOI. A program code P is also effective as a delimiter. When using a controller which outputs only CR, enter P at the end of progream codes.

Example: "F1N1S2P"

n. This adapter provides a reverse display function by which controller-created data are reversely sent to the counter to be displayed there. In this case, display values are transferred but no new measurements are performed.

Code	Function
M0	Measurement results of the counter are displayed.
M1	Values transferred from the controller are displayed.

Reverse display data format

Code
MD ddddddddddE± ee

Notes:
- d: 10 digits including a minus sign and a decimal point (i.e. up to 8 numeric values)
- When M1 has been sent, the display remote status (reverse display mode) starts with blanks being displayed. Because, at this point, the current measurement stops, send controller's data conforming to the reverse display data format.
- The reverse display mode is not released until M0 is sent.

Example:
"M1" Reverse display mode
"MD - 12345678. E-12" Reverse display data
:
"M0" Reverse display mode to be released

o. The setting codes of TR13007A extended functions are shown below. When these codes are used, it is assumed that the counter is TR5835 and is equipped with a TR15001 Key Unit.

① Setting of comparison mode

R0	CMP mode OFF
R1	CMP mode ON

Note: Mode 0 or mode 1 and a reference value must be set from the TR15001 beforehand.

② Setting of auto level mode

A0	ALM OFF
A1	ALM ON

Note: A minimum value trigger level and a reference pulse width value must be set from the TR15001 beforehand.

③ Setting of move operations

B0	RANGE
B1	MIN
B2	MAX

Note: Note that if R1 or A1 is set together with this code, this code is ignored.

④ Clear of move operation data
Z0: Not to clear
Z1: To clear

7.4.3 Initial Values

Each of the settings becomes as shown below when the power for this adapter is turned ON, or when a universal command DCL, an address designation command SDC or a program code C is received from the controller.

Statistical operation ..... T0 (σ)
Function ..... F2 (TEST)
Number of samples N0 (1)
Ssmple rate ..... S3 (approx. 160 ms)
Service request ..... S1 (SRQ is not sent)
Variable sample number ..... NV200 (200 samples)
Variable level constant ..... LV + 200 (200 mV)
Window constant (lower limit value) ..... WL 20000
Window constant (higher limit value) ..... WH 30000
Event constant (lower limit value) ..... XL 200
Event constant (higher limit value) ..... XH 300

7.4.4 Service Request

(1) Cause of serive request:
Data has occurred by a measurement end.

(2) Status byte:
After a service request has occurred, in repsonse to the serial polling by the controller, this adapter sends the following status byte to the controller.

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

D1 = "1"
To be set at a measurement end.

D3 = "1"
When comparator mode is ON, this bit is set in no-pass status

Note: In S1 mode (SRQ is OFF), D7 of this adapter does not become "1".

7.4.5 Error Messages

If an attempt is made to enter headers and codes which have not been designated, or constants which are outside the range, the following error messages are displayed on the counter's display section.

a. E-01 : Header error. A header other than one designated has been input.
Example: A0, Q1 etc.

b. E-02 : Code error. A code other than those designated has been input.
Example: F5, T9 etc.

c. E-03 : A constant outside the range has been input.
Example: NV12345, WL103

Note: For a or b, the setting input becomes invalid. For c, the constant's setting value becomes that of initialization.

7.4.6 Output Data Format in CMP Mode

When the TR5835 is operated in CMP mode together with a TR15001 Key Unit, measurement data are processed and output as shown below.

CMP mode	Status	TR5835 display	TR13007A output	TR13007 D/A output
Mode 0	GO	____ -!!!!!!!	0 data	0.000V
	NG	__!!!-!!!!!!!	0 data	0.000V
Mode 1	GO	PASS	0 data	0.000V
	NG	1.234 □ 2345 µs	S ␣␣1.234 1/0 2345E-6	+1.234V 4 higher digits are converted.

7.5 OPERATING PROCEDURES

7.5.1 Inspection

This adapter was thoroughly tested at the factory before shipment. However, when you receive this adapter, inspect for visible damage, particularly, the panel switches and terminals. If any damage is found or its operation is not satisfactory, please contact your nearest ADVANTEST representative.

7.5.2 Storage

If this adapter is not used for a long time, wrap it with a vinyl sheet, or similar material, or put it in a cardboard box and store the adapter in a place away from dampness and sunlight.

7.5.3 Cautions about Transportation

When transporting this adapter to another place, pack it up with the packaging material which was used when the adapter was first delivered. If the material has been lost, however, pack up the adapter in the following way.

① Wrap the adapter with a vinyl sheet or similar material.

② Wrap the adapter with a cushioning material, and put it in a cardboard box which is at least 5 mm thick.

③ Close and bind the cardboard box with packing strings.

7.5.4 General Cautions before Use

① Power
Before installing this adapter, make sure that the POWER switch of the counter is set to STBY.

② Environment
Avoid the use of this adapter in places exposed to such undesirable environmental conditions as dust, direct sunlight and corrosive gases.

③ Shock
Handle this adapter with care so that no serious mechanical shock (5 G or more) is given to this adapter.

7.5.5 Mounting Procedures

① Set the POWER switch of the counter to STBY, and disconnect the power supply cable from the counter.

② Detach the blank panel from the rear panel of the counter. (See Figure 7-4.)

③ Install this adapter as shown in Figure 7-5.

④ Connect the power supply cable to the counter, and set the POWER switch to ON. (Installation completed)

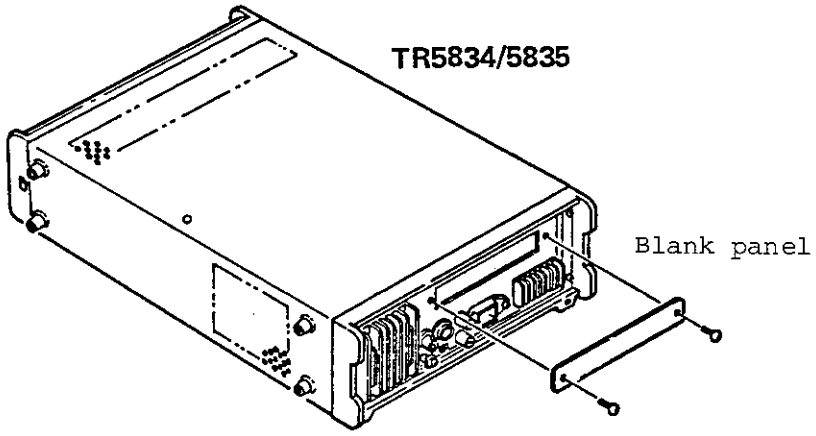


Figure 7-4 Disassembling the Blank Panel

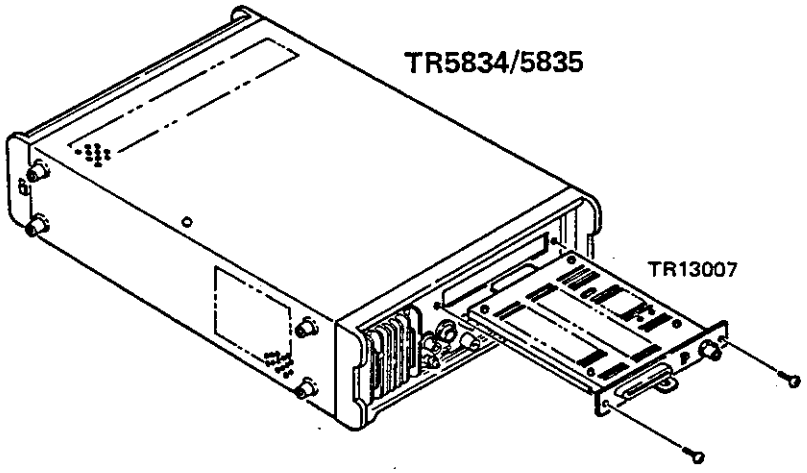


Figure 7-5 Mounting Procedures

7.5.6 Connection with Other System Components

Because a GPIB system comprises two or more devices, note the following points in preparing an overall system configuration.

(1) Before connecting a TR5834/TR5835, a controller, and peripheral equipment, see their operation manuals and understand the status (any preparation required) and operation of each device.

(2) Care should be taken so as not to let the bus cables which are connected with other measuring instruments and a controller to be longer than required. Make sure that the total bus cable length is up to (Number of connected devices) x 2 m and does not exceed 20 m.

As standard bus cables, ADVANTEST can provide the following cables.

Table 7-3 Standard Bus Cables (option)

Length	Name
0.5 m	408JE-1P5
1 m	408JE-101
2 m	408JE-102
5 m	408JE-104

(3) When connecting bus cables, do not stack 3 or more connectors. Fix the connectors firmly by their screws.

The bus cable connectors are of piggyback type (each connector has a female side and a male side) and may be used in piles.

(4) Before turning the power ON, make sure that the power supply condition, grounding status and, if required, setting condition of each device are fully satisfactory.

Turn ON the power switches of all the devices which are connected with the bus. If there is any device whose power is not turned ON, the operation of the whole system is not guaranteed.

(5) When detaching a bus cable, first disconnect the power supply cable from the AC receptacle.

7.5.7 Explanation of Panel and Top Cover

(1) Explanation of panel

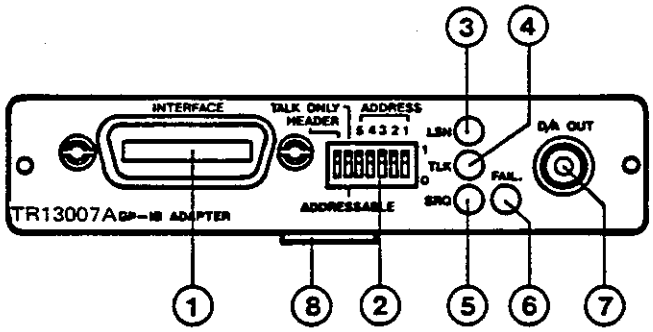


Figure 7-6 Explanation of Panel

① INTERFACE connector
This is a 24-pin connector for connecting a bus cable. As this is a piggyback type connector, standard bus cables can be connected here in piles (but not 3 or more connectors).

② ADDRESS switch
This is a DIP switch used to set a bus address (talker or listener address) of this adapter unit. From 1st bit to 5th bit are used to set an address code of this adapter unit. If 6th bit is set to ADDRESSABLE, it becomes possible for the controller to designate this address.
If the 6th bit is set to TALK ONLY, this adapter unit is fixed to be a talker regardless of the setting of address bits 1 to 5. If the 7th bit is set to 1, the header is sent when data are sent. If the 7th bit is set to 0, the header becomes a space code.

③ to ⑤ GPIB status lamps
If this adapter unit is controlled through GPIB, these lamps show its status as a device.

③ LSN (listen) lamp
This lamp shows that this adapter unit is addressed to listen to receive data.

④ TLK (talk) lamp
This lamp shows that this adapter unit is addressed to talk to send data.

⑤ SRQ (service request) lamp
This lamp shows that this adapter unit is in the status to send a service request to the controller.

⑥ FAIL lamp
This lamp lights if, after the power-ON, a fault has been detected during the self-diagnostics of the ROM, RAM, and ports by the CPU. When this lamp turns ON, it shows that this adapter unit is faulty. So, check the fault status by referring to Table 7-4 and contact your nearest ADVANTEST representative.

⑦ D/A OUT connector
This is a BNC type connector used to output an analog voltage.

⑧ Knob for detaching this adatper unit
This knob helps to detach this adapter. When detaching this adapter, remove the 2 screws at both ends on this adapter's panel and pull this knob.

(2) Explanation of top cover

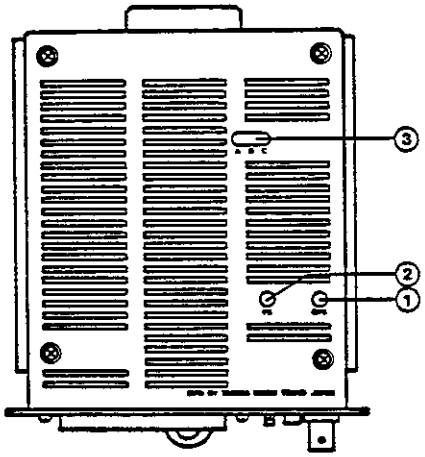


Figure 7-7 Explanation of Top Cover

① OFS control
This is an adjuster used to set the offset (+0.000 V). (Refer to Section 7.8 "Maintenance".)

② FS control
This is an adjuster used to set the full scale (+9.999 V). (Refer to Section 7.8 "Maintenance".)

③ A, B and C lamps
When the FAIL lamp on this adapter's panel lights, these lamps show the fault status detected by the self-diagnostics. See Table 7-4.

Table 7-4 Fault Status During Self-Diagnostics

A	B	C	Fault status
x	x	o	ROM fault
x	o	x	RAM fault

o ..... Lamp ON
x ..... Lamp OFF

7.5.8 Address Setting

A talk address and a listen address for this adapter unit in a GPIB system are set by the ADDRESS switch on this adapter's panel. This is a DIP switch having 7-bit positions, of which 5 address bits (ADDRESS 1 to 5) are set to an arbitrary address among 31 possible addresses. In Figure 7-8, for example, ADDRESS 1 to 5 are set to "00100" (4 in decimal). As Table 7-5 shows, ASCII code characters selected then are D (as a talker) and S (as a listener).
If the 6th bit is set to ADDRESSABLE, this adapter unit can respond only when a controller-designated address matches the address (set by ADDRESS 1 to 5) of this adapter. If the 6th bit is set to TALK ONLY, this adapter unit is fixed to be a talker regardless of the setting by ADDRESS 1 to 5. If the 7th bit is set to "1", the header consisting of 3 characters is sent when data are sent. If the 7th bit is set to "0", all of the 3 characters become space code.

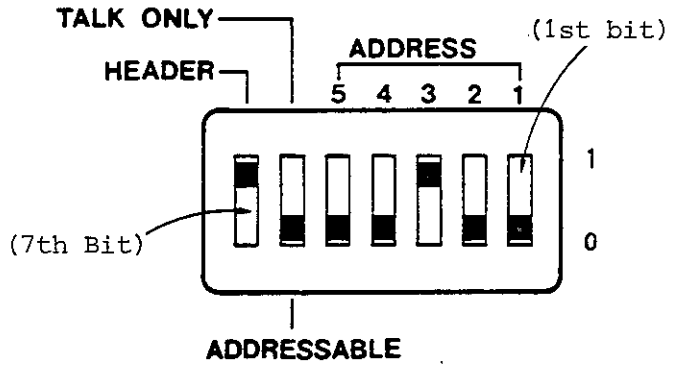


Figure 7-8 Address Switch

Table 7-5 Address Code List

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

7.5.9 General Cautions about Operation

(1) Caution about the use of ONLY mode
If this adapter is to be used in ONLY mode, make sure that the ADDRESS switch on this adapter's panel is set to TALK ONLY and the address of the other device which is connected through the bus is also set to ONLY mode. When ONLY mode is thus used, however, do not use (operate) the controller simultaneously. If the controller is used in ONLY mode, this adapter unit ignores commands from the controller, and so its normal operation cannot be guaranteed.

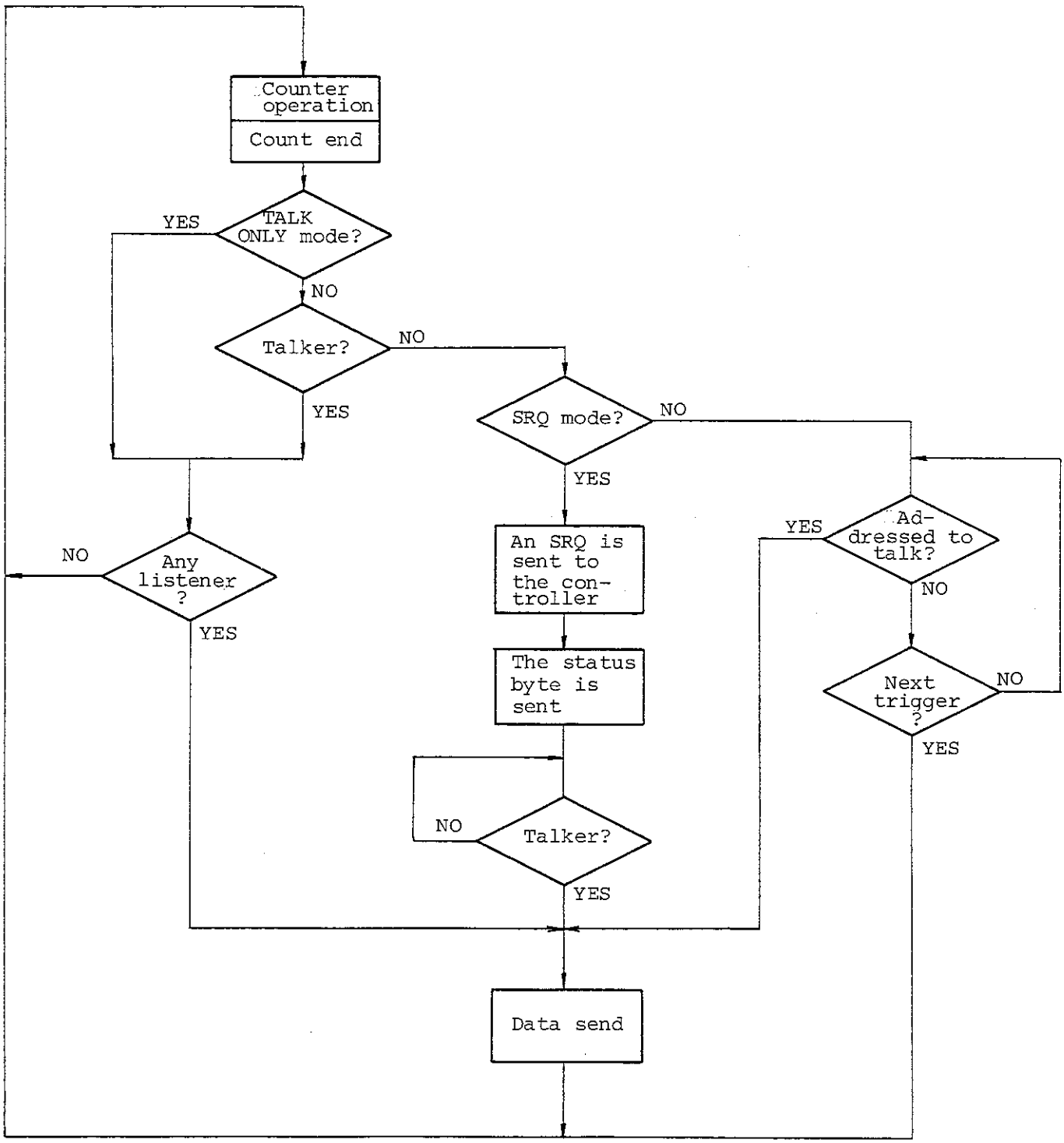
(2) Power failure during operation
If a power failure (including an instantaneous one) occurs during the operation of a GPIB system which includes this adapter unit, no normal operation is guaranteed. Normally, all settings are initialized after power recovery. Attention should be also paid to other devices of the system concerning power failure processing.

(3) Interrupts by the controller during data transfers between devices.
In a GPIB system, it is possible to transfer data between devices which are not controllers.
During a data transfer between the devices (handshaking), if the controller attempts to interrupt it to switch to serial poll mode or to address another device to listen, the data transfer between the devices is interrupted to give priority to the operation of the controller. After the interrupt operation has ended, the previous data transfer continues.
Generally, it is advisable to make programs so that during data transfers between the devices, the controller is in a position to know the data transfer status.

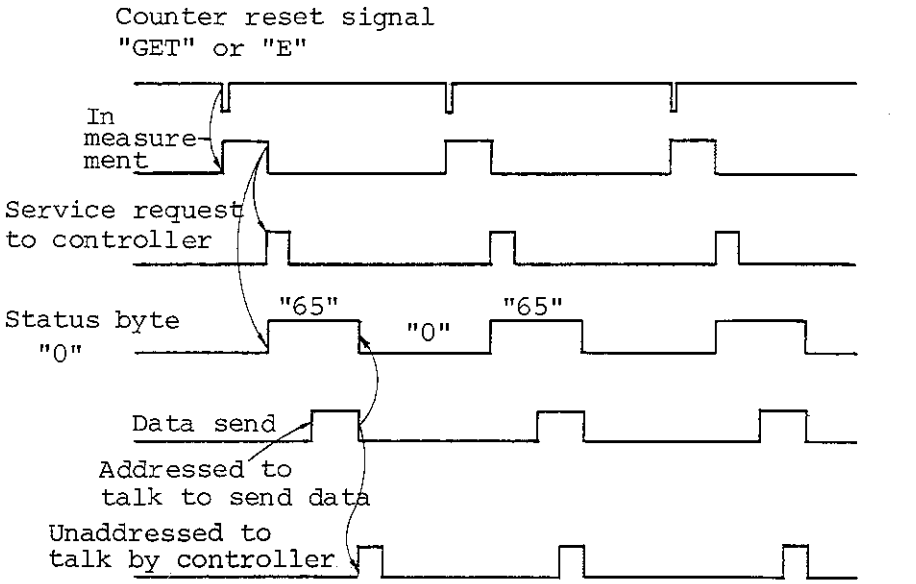
(4) Change of the ADDRESS switch setting during operation
If the setting of the ADDRESS switch of this adapter unit is changed during the operation of the counter, the new setting is ignored and the old address is used. Therefore, changing of the ADDRESS switch setting needs to be done before the power-ON.
This is equally true for TALK ONLY-ADDRESSABLE switch. However, if the HEADER setting is changed during the counter operation, the operation follows the chnange immediately.

(5) Outlined operation flowchart (data send)

* The interrupt will end if, when an interrupt occurs in SRQ mode, an attempt is made to address a device to talk and to let to send data but not to perform any interrupt processing.



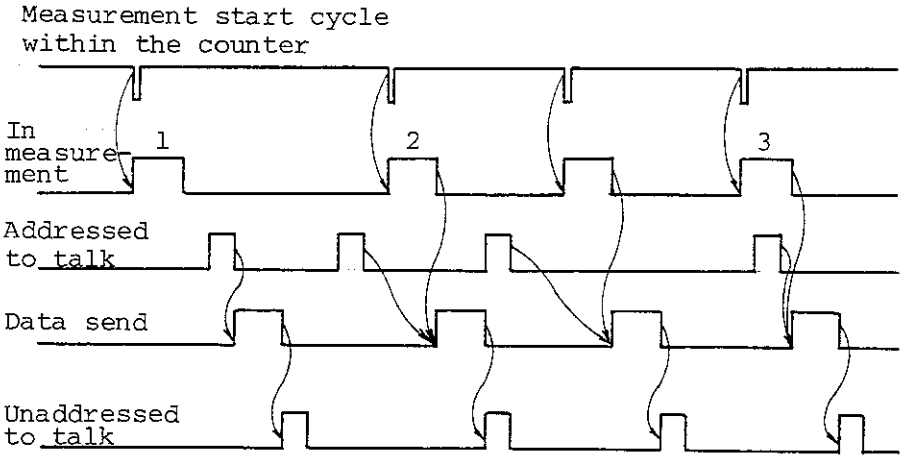
(6) Operation during service request



(Unaddressed to talk if addressed to listen by a GET or E code, or an un-talker command is sent.)

(7) Data send timing if addressed to talk

The timing of data send if addressed to talk is shown below. If the counter is addressed to talk, the counter can send data only once at or after the end of a measurement.



(If a measurement start is commanded by a GET or E code, no un-talker command is required. The device is unaddressed to talk if addressed to listen.)

① If the counter is addressed to talk after the end of a measurement, the counter immediately outputs data.
② If the counter is addressed to talk after sending data once, the counter will output data when the next measurement ends.
③ If the counter is addressed to talk during a measurement, the counter will output data after the measurement ends.

7.6 PRINCIPLES OF OPERATION

This adapter unit includes a microprocessor which exchanges data with the counter. This microprocessor controls an interface microprocessor and exchanges data with the GPIB bus. The interface microprocessor is connected through a transceiver to the GPIB bus. A D/A converter receives binary data from the microprocessor and converts the data into an analog value. The analog value is then amplified and output to the D/A OUT connector.

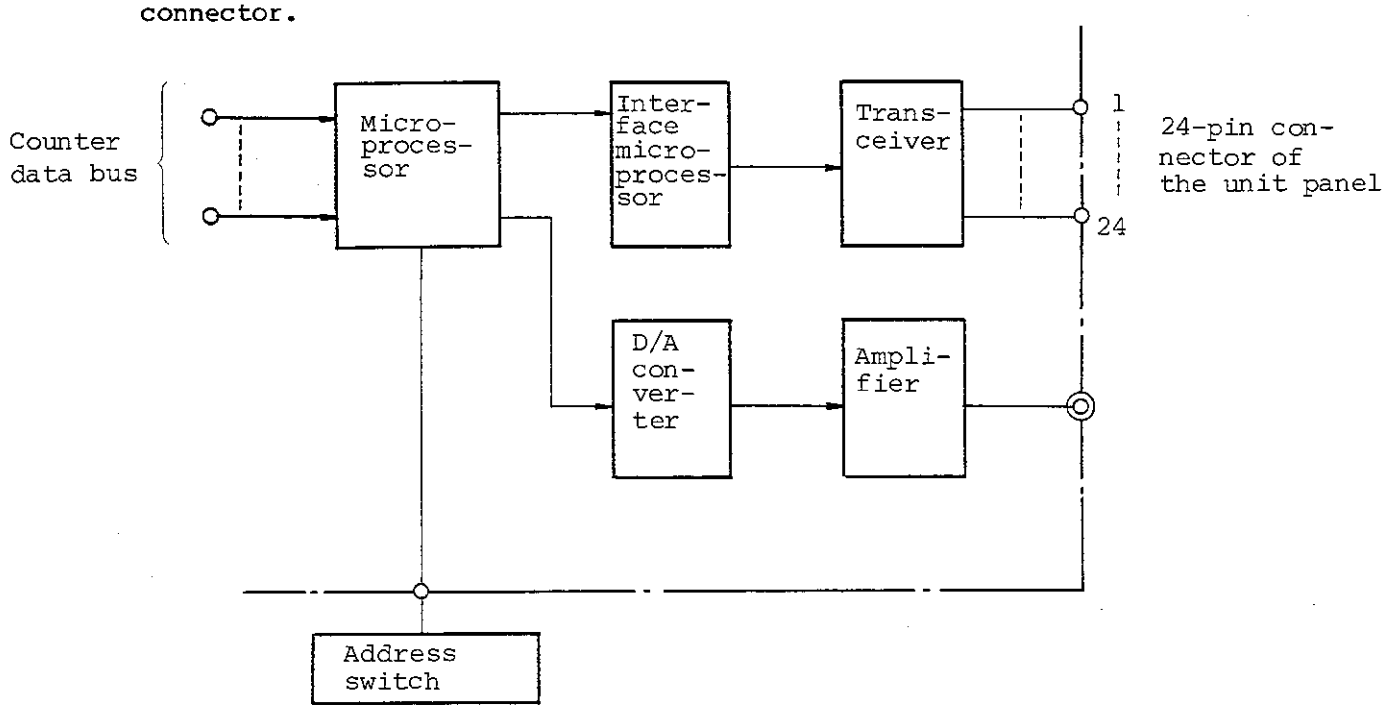


Figure 7-9 Simplified TR13007 Configuration Diagram

7.7 PERFORMANCE CHECKS

7.7.1 GPIB

Refer to the program examples given at the end of this chapter. If the same data as those shown in the examples are not obtained, contact your nearest ADVANTEST representative.

7.7.2 D/A Output

① Connect a voltmeter (whose resolution is 1 mV and which can measure up to +10 V) to the D/A OUT connector of this adapter unit.
② Make sure that the same data as those shown in the program examples at the end of this chapter are obtained, and that after the controller print (or display) operation ends, the voltmeter reading is within the conversion accuracy in relation to the 4 lower digits display of the counter.

If the voltmeter reading fails to be within the conversion accuracy in the above check, refer to (2) "D/A OUT Adjustments" in Section 7.8 and adjust the offset (+0.000 V) and the full scale (+9.999 V).

7.8 MAINTENANCE

(1) FAIL lamp

When the FAIL lamp lights, it shows that a fault has been detected during the self-diagnostics. Confirm the fault status and contact your nearest ADVANTEST representative.

To confirm the fault status, see Figure 7-10 and 7-11, disassemble the rear frame and the case, and check A, B and C lamps by referring to Table 7-4.

(2) D/A OUT adjustments

If the voltmeter reading has failed to be within the conversion accuracy in the check of Section 7.7.2, perform adjustments in the following way.

① Set the POWER switch of the counter to STBY, and disconnect the power supply cable.
② Remove the 4 screws on the counter's rear panel as shown in Figure 7-10. (For the TR5835, first detach the cover of the TR15001 connector.)

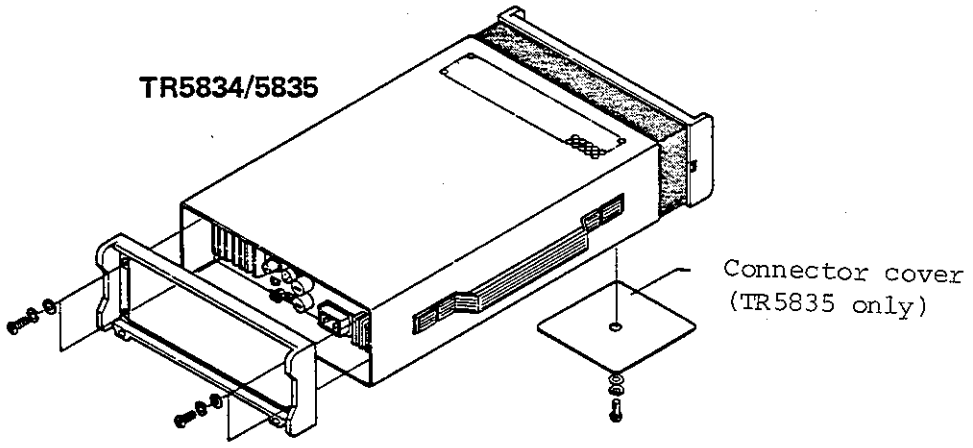


Figure 7-10 Disassembling the Screws and the Connector Cover

③ As shown in Figure 7-11, detach the rear frame and the case.

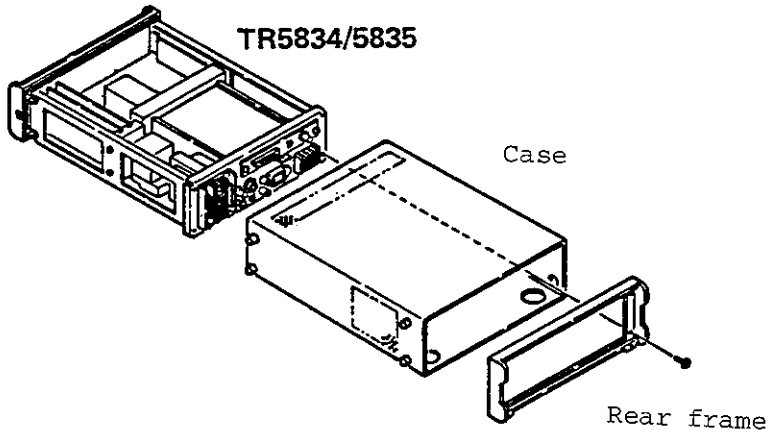


Figure 7-11 Disassembling the Rear Frame and the Case

④ Connect a voltmeter (whose resolution is 1 mV and which can measure up to +10 V) to the D/A OUT connector of this adapter unit.
⑤ Connector the power supply cable to the counter, and set the POWER switch to ON.
⑥ Let the controller repeatedly execute the program which receives 4 lower digit display data of "0000" of the counter. In this status, set the OFS adjuster on the adapter's top cover to +0.000 V (by rotating the adjuster clockwise or counterclockwise by a Phillips-head screwdriver).
⑦ Let the controller repeatedly execute the program which receives 4 lower digit display data of "9999" of the counter. In this status, set the FS adjuster on the adapter's top cover to +9.999 V (by rotating the adjuster clockwise or counterclockwise with a phillips-head screwdriver).
⑧ Repeat adjustments in ⑥ and ⑦, and confirm the voltage values.
⑨ After all operations described above have ended, set the POWER switch to STBY, disconnect the power supply cable and the cable which has been connected to the D/A OUT connector and attach the rear frame and the case in the order opposite to their previous detachment procedures. Now, the D/A OUT adjustments have been completed.

Never touch any part other than the adjusters with the screwdriver, etc. (particularly when the POWER switch is turned ON).

If you fail to satisfy the conversion accuracy even after the above-described adjustments have been tried, contact your nearest ADVANTEST representative.

[Program example]

Examples of actual programs are shown below. Here, HP9825A is used as the controller.

(1) After setting functions, the counter is addressed to talk to send data.

● Program example

```
0:  dim A$[19]
1:  wrt 701,"F1T0
 NO"
2:  red 701,A$
3:  prt A$;spc 1
4:  wait 1000
5:  gto 2
6:  end
*32562
```

Explanation of program

0: An area which stores all of 20 characters (from the header) is defined.
1: PERIOD (period) measurement, standard deviation, sample number (1 sample) setting.
2: Data read.
3: Print output of data.
4: Waits for 1 second.
5: Returns to line 2 and read data.

● Data output

```
S   5.30000000E-0
6

S   5.30000000E-0
6

S   5.30000000E-0
6

S   5.30000000E-0
6

S   5.30000000E-0
6

S   5.30000000E-0
6
```

Explanation of data output

S: Header which shows a period measurement.
5.30000000E-06: This shows 5.30000000 µs.

(2) A program which outputs 19 characters

● Program example

```
0:  cir 701
1:  wrt 701,"S5"
2:  trg 701
3:  rdb(701) A;
 fxd 0
4:  prt A
5:  if A=10;gto 7
6:  gto 3
7:  end
*12926
```

Explanation of program

0: Sets the counter to its initialization status.
1: Sets to HOLD.
2: GET command.
3: Reads data byte-by-byte.
4: Prints out data.
5: Checks LF.
6: If not LF, returns to line 3.

● Data output

```
 83
 32
 32
 49
 46
 48
 48
 48
 48
 48
 48
 48
 48
 48
 69
 45
 48
 55
 13
 10
```

Explanation of data output

	ASCII
83:	S
32:	␣
32:	␣
49:	1
46:	.
48:	0
48:	0
48:	0
48:	0
48:	0
48:	0
48:	0
48:	0
48:	0
69:	E
45:	-
48:	0
54:	4
13:	CR
10:	LF

(3) Program which sets functions of the counter and reads data by SRQ

● Program example

```
0:  dim A$[19]
1:  clr 701
2:  oni 7,"SRW"
3:  wrt 701,"F1T0
 NO"
4:  eir 7
5:  jmp 0
6:  "SRW":rds(7)
 S;gto 8
7:  if bit[6,rds[
 701]];gto 12
8:  wait 5000
9:  trg 701
10:  eir 7
11:  iret
12:  red 701,A$
13:  prt A$;spc 1
14:  gto 8
15:  end
*8621
```

Explanation of program

0: An area which stores all of 19 characters (from the header) is defined.
1: Sets the counter to its initialization status.
2: Defines an interrupt processing routine.
3: PERIOD (period) measurement, standard deviation, sample number (1 sample) setting.
4: Enables interrupts.
5: Waits for interrupts.
6: Judges whether or not it is an interrupt from port 7 to which the counter is connected.
7: Performs a polling to know if it is an interrupt from the counter.
8: Waits for 5 seconds.
9: GET command.
10: Enables interrupts.
11: Returns from the interrupt processing routine to the main routine.
12: Reads data.
13: Prints out data.
14: Returns to line 8.

● Data output

```
S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6

S    2.00000000E-0
6
```

Explanation of data output

S: Header which shows a period measurement.
2.00000000E-06: This shows 2.000000000 µs.

(4) To measure once in HOLD sample rate status, and sequentially output 5 types of statistical operation resutls (σ, RANGE, MIN, MAX, MEAN).

● Program example

```
10    DIM A$[20]
20    ENTER 705;A$
30    PRINT "-----------"
40    OUTPUT 705;"S5N1F0"
50    TRIGGER 705
60    S=SPOLL(705)
70    DISP S
80    IF S=0 THEN 60
90    FOR T=0 TO 4
100   OUTPUT 705;"T",T
110   ENTER 705;A$
120   PRINT A$
130   NEXT T
140   PRINT "*************************"
150   GOTO 50
160   END
```

Explanation of program

10: An area which stores all of 20 characters (from the header) is defined.

20: Dummy read (See Note 2.)

40: Sets HOLD, 200 samples, WIDTH. (See Note 3.)

50: Starts a measurement.

60: Loads measurement end status into the controller.

70: Monitors measurement end status on the controller display.

80: Waits if it is not measurement end status yet.

90 - 130: For each of the sequential settings T0 to T4, data are read and printed out.

150: Moves to the next measurement.

Notes 1: In this program, HP9836 is used as the controller and TR13007 address is set to "5".

2: Because, in HOLD mode, the end bit (i.e. serial port bit) is enabled by the previous measurement, a dummy read is used to clear the bit.

3: In this program, if "NO" (sample number = 1) is set, the measurement is performed but data are not sent.

● Data output

```
------------
S  3.90000000E-08
S  1.47000000E-07
S  5.72136500E-04
S  5.72283500E-04
S  5.72191640E-04
************************
S  3.40000000E-08
S  1.72700000E-07
S  5.72090800E-04
S  5.72263500E-04
S  5.72183170E-04
************************
S  3.50000000E-08
S  1.38200000E-07
S  5.72131600E-04
S  5.72269800E-04
S  5.72193470E-04
************************
S  3.40000000E-08
S  1.43100000E-07
S  5.72138100E-04
S  5.72281200E-04
S  5.72196750E-04
************************
```

Explanation of data output

S: Header which shows a time measurement.
3.90000000E-08: This shows 3.90000000 µs.

(5) Using CMP mode, only no-pass data are output to a printer.

```
1    DIM A$[20]
10   OUTPUT 701;F0S5S0
20   OUTPUT 701;"R1"
30   TRIGGER 701
40   S=SPOLL(701)
50   DISP S
60   IF S<>69 THEN 40
70   ENTER 701;A$
80   PRINT A$,S
90   GOTO 30
100  END
```

10: "WIDTH", "HOLD", and "with SRQ" are set.
20: "CMP" mode ON.
30: Starts a measurement.
40: Loads measurement end status into the controller.
50: Monitors measurementend end status on the controller display.
60: Waits if it is not a measurement end or if data is not no-pass data.
70: Reads data into the controller.
80: Prints out data and measurement end status.
90: Moves to the next measurement.

Notes 1: In this program HP9816 is used as the controller and TR13007A address is set to "1".
2: The CMP mode in this measurement is "1", which needs to be set in local status.

● Data output

```
S  9.25016000E-08   69
S  9.26016000E-08   69
S  9.24016000E-08   69
S  9.26016000E-08   69
S  9.28016000E-08   69
S  9.26016000E-08   69
S  9.26016000E-08   69
S  9.25016000E-08   69
S  9.25016000E-08   69
S  9.26016000E-08   69
S  9.23016000E-08   69
S  9.27016000E-08   69
```

Explanation of data output

S: Header which shows a time measurement.
2.25016000E-08
: This shows 92.50 ns and -6000 mV.
69: This shows a measurement end status.

8. TR15001 KEY UNIT

8.1 INTRODUCTION

The TR15001 Key Unit is an optional accessory used to improve the operational aspects of, and expand the measuring functions of a TR5835 Pulse Jitter Counter. (TR15001 cannot be used with TR5834.)

If this key unit is connected to the TR5835, it becomes possible to set numeric parameters through the numeric keys and such move operations as RANGE, MIN and MAX, comparison function, and auto-level mode (ALM) are also available.

In particular, when the comparison function is used, if a TR13006 BCD Output Unit is used together, the judgement result is obtained as a logic signal which may be used for fault analysis.

8.2 SPECIFICATIONS

Functions:

- Setting of numeric parameters:
  Trigger level, window, sample number, time delay and event count delay can be set by the number keys.
- Move operations:
  Move range, move minimum value and move maximum value are calculated, and one of these values is displayed.
- Comparison:
  ① Mode 0
    a. When [measurement value] ≦ [setting value], the difference for the setting value is displayed by a bar.
    b. When [measurement value] > [setting value], the difference is displayed by a bar.
  ② Mode 1
    a. When [measurement value] ≦ [setting value], "PASS" is displayed.
    b. When [measurement value] > [setting value], the measurement value and the trigger level are displayed.
  ③ TR13006 Amphenol connector output

Status

Pin number	"a" mentioned above	"b" mentioned above
38	0	1
39	1	0

Note: The output buffer is equivalent to LS TTL.

- Auto-level mode:
  In the measurement of a pulse width, a trigger level is obtained by a formula shown below and, then, the trigger level is automatically set to measure.

$$\frac{(W_0 - W_2)\ L_1 + (W_1 - W_0)\ L_2}{W_1 - W_2}$$

where

L_1: Minimum value of trigger level which is set beforehand.
L_2: Maximum value of trigger level which is set beforehand.
W_0: Reference pulse width value which is set beforehand.
W_1: Pulse width value which has been measured by the trigger level L1.
W_2: Pulse width value which has been measured by the trigger level L2.
Lx: Trigger level whcih is set during the measurement.

This mode may be used together with comparison mode.

Number of digits in setting values:

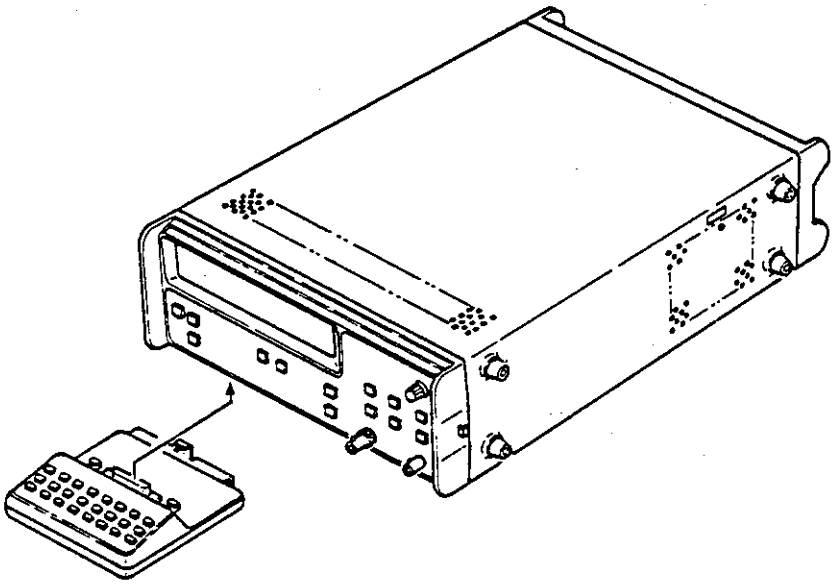
- Trigger level value:
  1 sign digit, up to 4 numeric value digits, unit [V], range -5.000 V to +5.000 V
- Window value:
  Up to 8 numeric value digits, unit [µs], range 0.0125 µs to 1250.0000 µs or 1.25 µs to 125000.00 µs. (Either range is selected by a switch on TR5835's rear panel.)
- Sample number:
  Up to 5 numeric value digits, no unit, range 10 to 10000
- Time delay quantity:
  Up to 8 numeric value digits, unit [µs], range 0.0125 µs to 1250.0000 µs
- Count delay quantity:
  Up to 6 numeric value digits, no unit, range 1 to 100000
- Input data in auto-level mode:
  Up to 7 numeric value digits, unit [µs], range 0.0000 µs to 9999999 µs
- Input data in comparison mode:
  Up to 7 numeric value digits, unit [µs], range 0.0000 µs to 9999999 µs

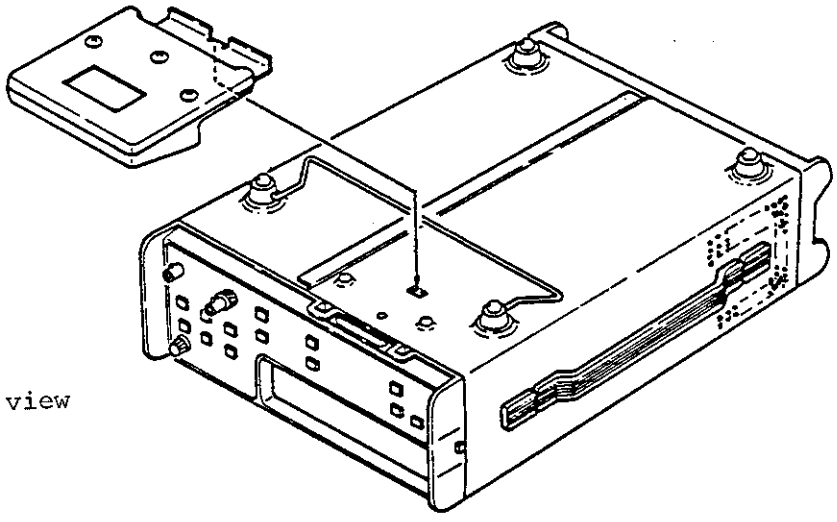
Operation part: 24 key switches, 6 LED units.
Dimensions : 101 (W) x 27 (H) x 112 (D) mm
Weight : About 150 g

8.3 OPERATING PROCEDURES

8.3.1 Detachment Procedures

Before attaching or detaching this key unit, set the POWER switch of the counter to STBY.



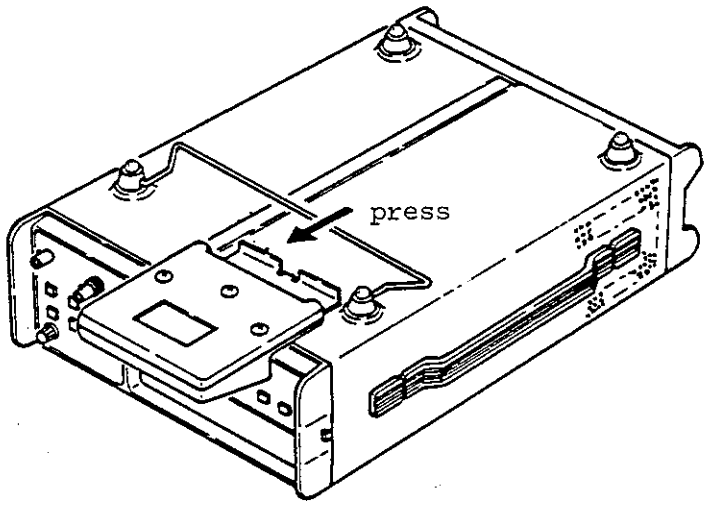


Bottom view

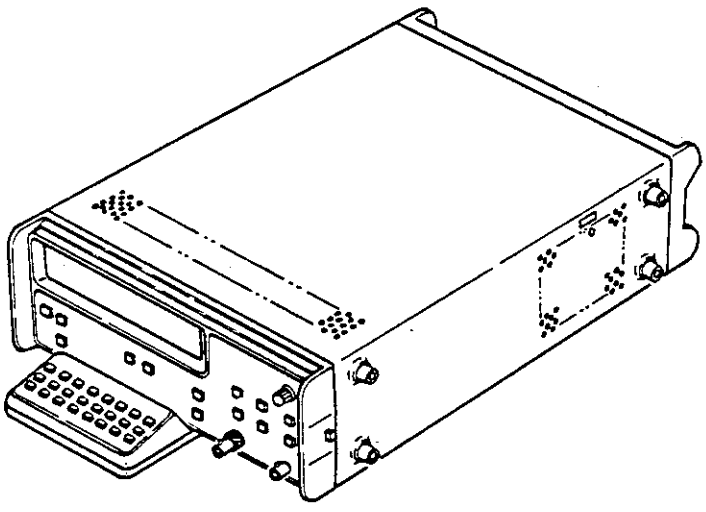
① Pull out the hook of the metallic part.

② Let the hook of the metallic part meet with the square pit, and the male connector with the female connector, at the back of the counter, and press the key unit against the counter's back.

③ For locking, press the metallic part toward TR15001.



Bottom view



For locking, press the metallic part toward TR15001.

8.3.2 Name and Function of Each Component

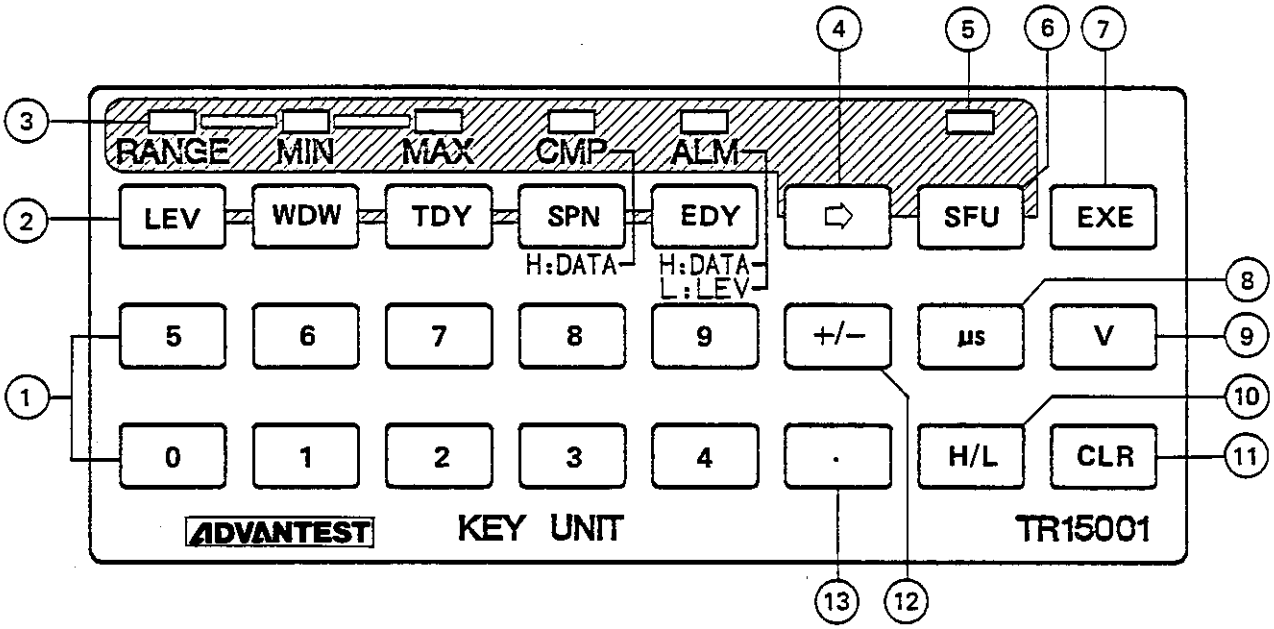


Figure 8-1 Explanation of Panel

① [0] to [9] keys
These are numeric key switches used to set numeric data.

② Parameter selection keys
These keys are used to select the predetermined parameters whose values are to be read or rewritten.

[LEV]: This key selects the trigger level. In auto-level mode, this is treated as the maximum value of trigger level.

[WDW]: This key selects the window values. [H/L] key is used to select the higher limit value or the lower limit value.

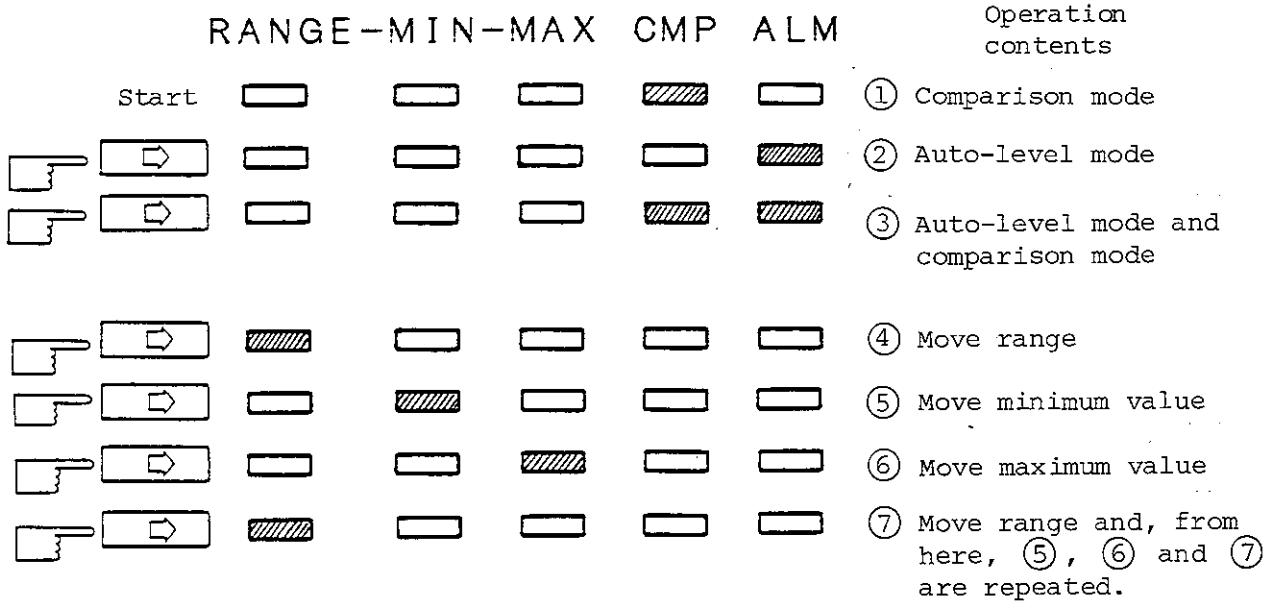
[TDY]: This key selects time delays. [H/L] key is used to select the measurement start delay or the measurement end delay.

[SPN]: This key selects sample numbers. In comparison mode, H/L key is used to select the reference data (H side) or the sample number (L side). In addition, when [H/L] key is set to H side, pressing [+/−] key switches H0 (comparison mode 0) and H1 (comparison mode 1).

[EDY]: This key selects event delays. [H/L] key is used to select the measurement start event delay or the measurement end event delay. In auto-level mode, H side gives the reference pulse width value and L side gives the minimum value of trigger level.

③ Special function indicator lamps
These lamps indicate the special function modes which are selected.
RANGE: The move range (i.e. the largest value among the difference between minimum values and maximum values which have been obtained in the past) is displayed.
MIN : The move minimum value (i.e. the smallest value among the data which has been obtained in the past) is displayed.
MAX : The move maximum value (i.e. the largest value among the data which has been obtained in the past) is displayed.
CMP : Comparison mode
AML : Auto-level mode

④ [⇨] key
This key is used to select individual special function modes. After pressing [SFU] ⑥ to enter into the special function mode status, press this key as many times as required to obtain the intended special function mode. (The ON indicator lamp(s) moves as shown below.)



⑤ SFU (special function) lamp
This lamp lights in the status of special function modes.

⑥ [SFU] (special function) key
If this key is pressed, SFU lamp lights entering into the status of special function modes. Then, the comparison mode is set first. If this key is pressed again, the SFU lamp turns OFF releasing the status of special function modes.

⑦ [EXE] (execute) key
This key is used to move from the status of reading or rewriting numeric parameters to the measurement operation.

⑧ [μs] key
This unit key is used when number parameters are set in time dimension.

⑨ [V] key
This unit key is used when the trigger level value is set.

⑩ [H/L] key
When some numeric parameters require 2 values to be set, this key is used to select the 2 values.

⑪ [CLR] key
This key is used to clear the currently setting numeric data into all blanking status. However, those data once recognized and stored in the internal registers are not cleared by this key operation.

⑫ [+/−] key
This key is used to set the polarity of a trigger level. In comparison mode, this key selects mode 0 and mode 1.

⑬ [·] key
This key is used to set a decimal point for numeric data. When setting a no-unit quantity, this key must be pressed at the end of the data in place of a unit key.

8.4 OPERATING PROCEDURES

(1) Setting of numeric parameters

The setting of a numeric parameter ends when its data has been transferred to the internal register. Execution of the data transfer is triggered by [μs] or [V] unit key or [·] key. So, after setting a numeric value, press a unit key which is the same as the TR5835 display section. For no-unit data, however, press [·] key. After being sent by these keys, the data appears in a specially modified format on the TR5835 display section.

(2) Operation examples (not in special function modes)

① Setting of a trigger level

[LEV]	␣␣␣␣0.200␣V
[+/−] [1] [·] [2] [3] [4]	
	␣␣␣−1.234␣
[V]	␣␣␣−1.232␣V

Note: Because the setting resolution is approx. 2.5 mV, 0, 2, 5 or 7 needs to be used in the mV digit position. If any numeral other than these is used, it is modified to the (smaller) nearest number as shown above.

② Setting of a window

WDW	0002.0000 Lμs
[0] [·] [5] [7] [5]	␣␣␣␣0.575 L
[μs]	0000.5750 Lμs
[H/L]	0003.0000 Hμs
[0] [·] [8]	␣␣␣␣␣␣0.8 H
[μs]	0000.8000 Hμs

Note: Because the setting resolution is 12.5 ns, the setting value needs to be a multiple of this value. If a number whose 3 digits in 10 ns, 1 ns and 0.1 ns positions are different from any of 000, 125, 250, 375, 500, 625, 750 and 875 is entered, the number is modified to the nearest number.

③ Setting of a time delay
This is done in the same way as the setting of a window in ② above.

④ Setting of a sample number

SPN	␣␣␣00200.␣
1 2 3 4	␣␣␣␣1234␣
.	␣␣␣01234.␣

⑤ Setting of event delays

EDY	␣␣000200.L
1 2 3 4	␣␣␣␣1234L
.	␣␣001234.
H/L	␣␣000200.H
2 0 0 0	␣␣␣␣2000H
.	␣␣002000.H

(3) Operation examples in special function modes

① In CMP mode (The CMP lamp needs to be turned ON beforehand.)

SPN	(L side for a smaple number)	␣␣000200.L
H/L	(H side for reference data)	000.0200H0 s
0 . 0 3		␣␣␣␣0.03H0
μs	(Sets the reference data)	00000.03H0 s
+/−	(Changes from mode 0 to mode 1)	00000.03H1 s

EXE (Starts a measurement)

② In ALM mode (The ALM lamp needs to be turned ON beforehand.)

LEV	␣␣␣␣0.200␣V
1 . 5 V	(Sets a maximum value level.)
	␣␣␣␣1.500␣V
EDY	␣␣␣␣0.200LV
1 . 0 V	(Sets a minimum value level.)
	␣␣␣␣1.000LV
H/L	0002000␣Hμ.s
0 . 6 9 4 μs	(Sets a reference pulse width value.)
	0000.694␣Hμs

EXE (Starts a measurement.)

8.5 CAUTIONS

(1) When setting a numeric parameter, if a setting value exceeds its allowable range, the value is not transferred to the interal register and the setting register is cleared.

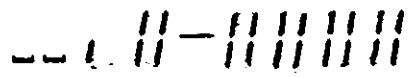
Example:

[LEV]	␣␣␣␣0.200␣V
[6] [.] [5] [4]	␣␣␣␣␣6.54␣
[V]	␣␣␣␣␣␣␣␣.

(2) Display in CMP modes

① Mode 0

a. When reference data were set to 0.020 µs and a measurement value is 25.6 ns, it is displayed as shown below.



b. One "1" corresponds to 2 ns and one segment corresponds to 1 ns. (When the reference data is 0.02 µs, each weight becomes 10 times larger. That is, the weight of one segment is the weight of the last digit position of setting values.) If any "1" segment lights to the left of "-" segment, it shows that the measurement value has exceeded the setting value. In the example shown above, the display range is 20 ns ± 16 µs.

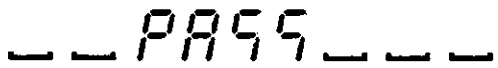
c.  When the measurement value becomes smaller, the segments turn OFF in the order shown left.

d. When the measurement value becomes smaller, segments disappear from left to right.

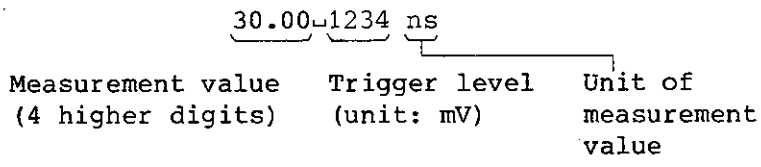
e. When the measurement value becomes equal to or smaller than the setting value, the display to the left of "-" segment becomes blank as shown below.

② Mode 1

a. When the measurement value is equal to or smaller than the setting value, the display is as shown below.



b. When the measurement value is larger than the setting value, the display is as shown below.



(3) Because [WDW] and [TDY] use the internal registers in common, if either operation changes its setting, it will affect the operation of the other operation. (When an operation of [WDW] is in progress, if a new setting of [TDY] is made, it will also change the [WDW] contents.)

(4) Because [EDY] and ALM use the internal registers in common, if they are to be used alternately, set the required numeric values beforehand.

(5) The trigger level shown above in b. of ② refers to a trigger level calculated in ALM. With other than ALM, an undefined value is displayed.

(6) When using in ALM, cautiously select a maximum value and a minimum value of trigger level. If the selected range fails to catch the signal, the measurement operation stops.

8.6 PRINCIPLES OF OPERATION

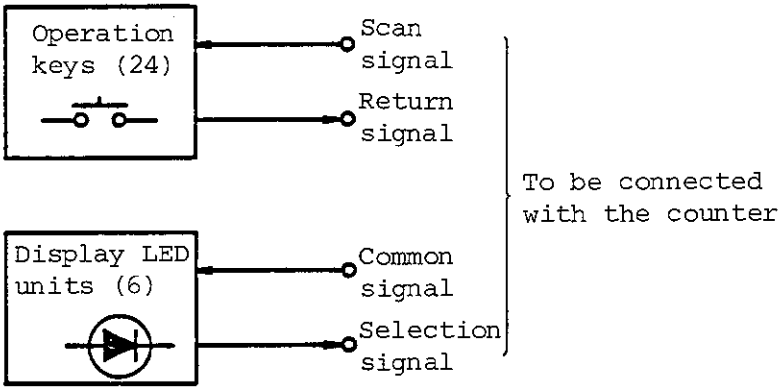


Figure 8-2 TR15001 Configuration

Figure 8-2 shows a configuration of this key unit, which includes 24 operation key switches and 6 LED units. This key unit consists of one formed conductive rubber sheet and one flexible printed circuit board. If a key is pressed, an interrupt signal directly enters into the microprocessor of the counter. The 6 LED units are driven by the LED drivers of the counter.

8.7 PERFORMANCE CHECKS

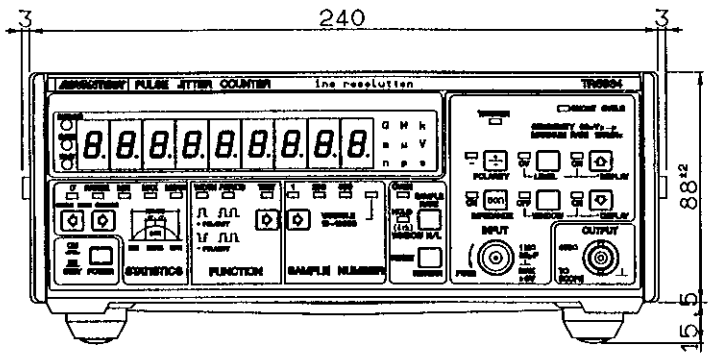
(1) Turn-ON check of LED

When the POWER switch of the counter is turned ON, the check mode of the counter's display section is executed. At the same time, 6 LED units of this key unit are checked and, if they are normal, they turn ON.

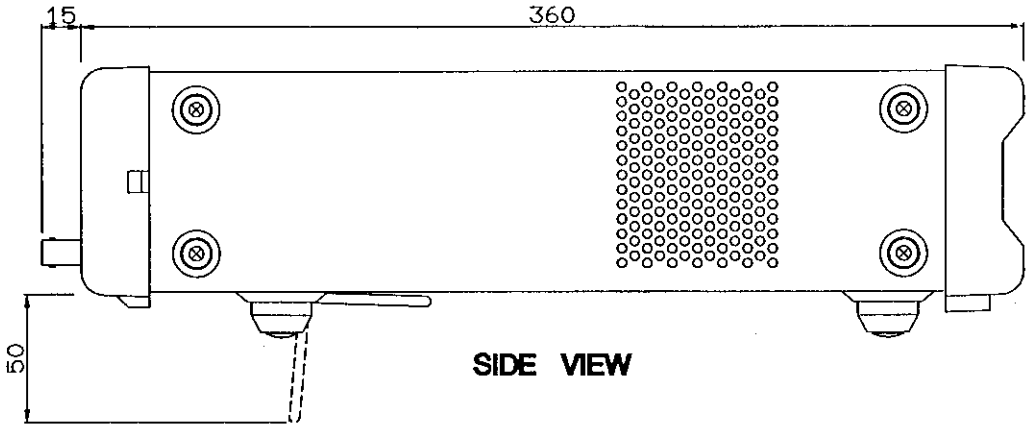
(2) Check of key switches and unit's operation

Perform the operation examples described in Section 8.4 for checking purpose.

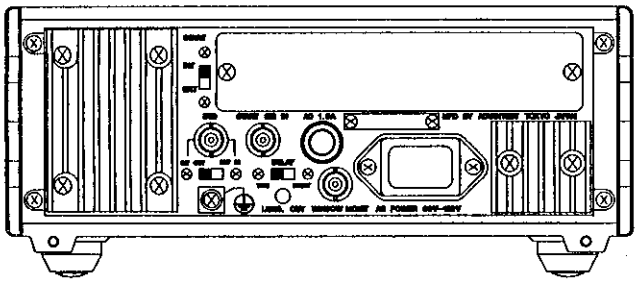
MEMO



FRONT VIEW



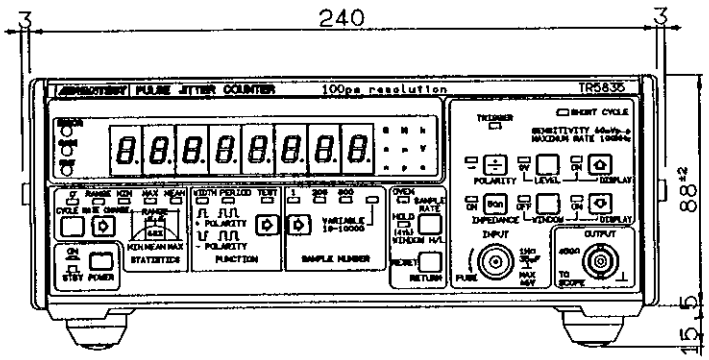
SIDE VIEW



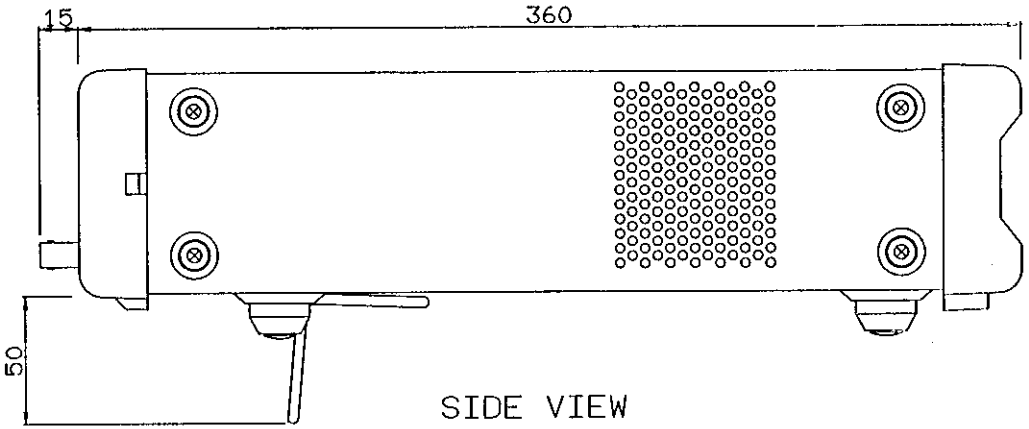
REAR VIEW

TR5834 EXTERNAL VIEW

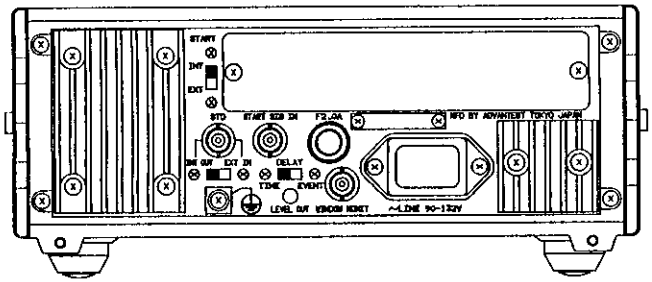
5834EXT1-512-C



FRONT VIEW



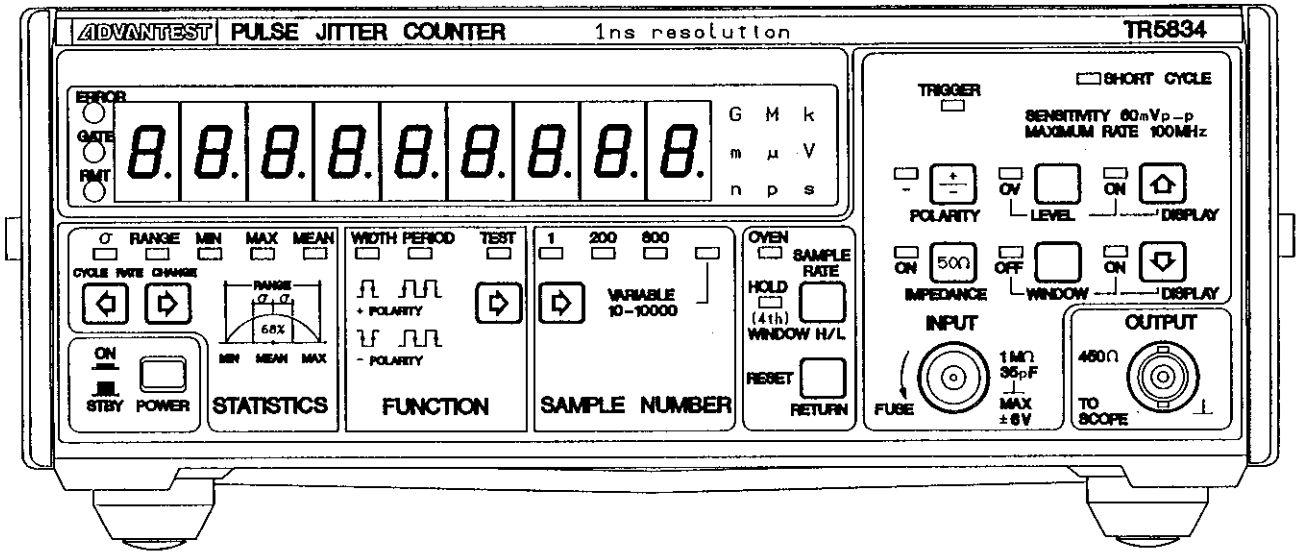
SIDE VIEW



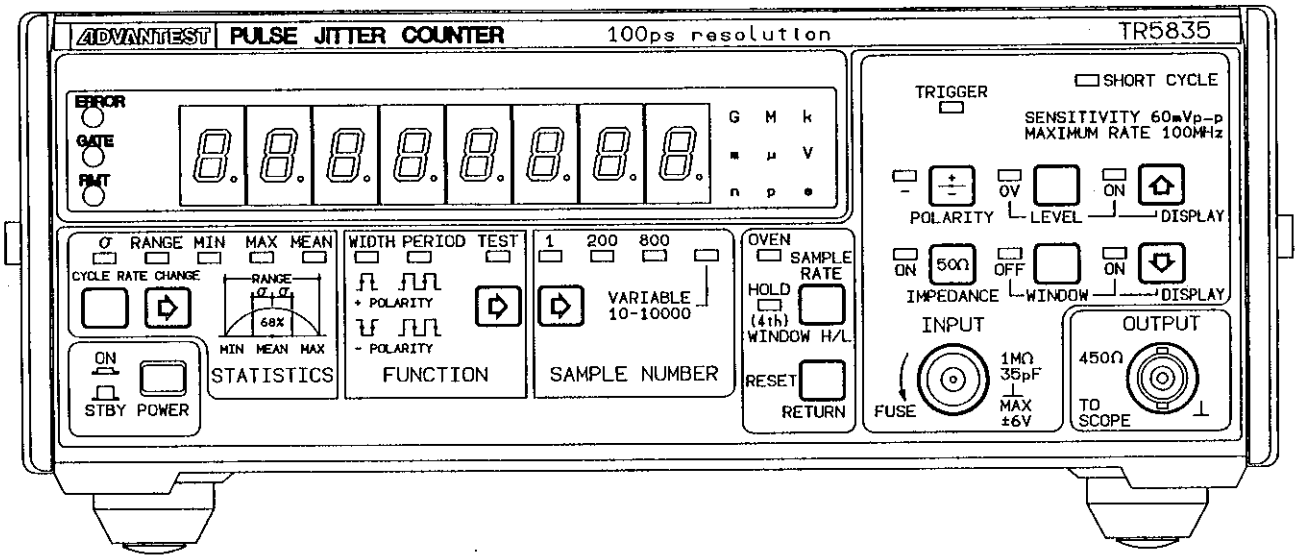
REAR VIEW

TR5835
EXTERNAL VIEW

5835EXT2-509-A

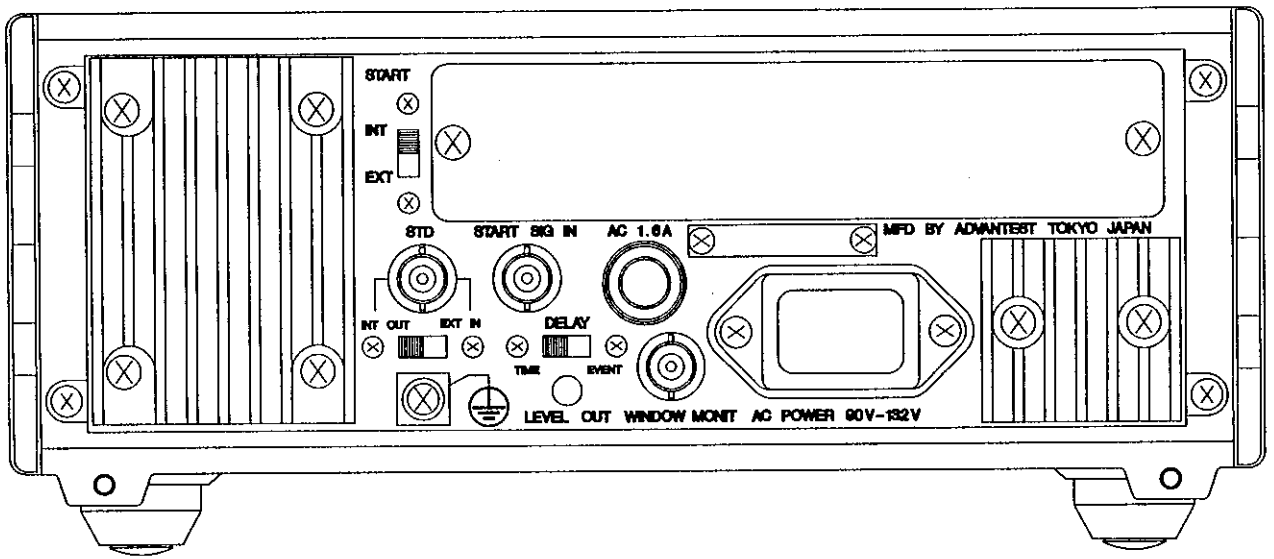


TR5834 FRONT VIEW



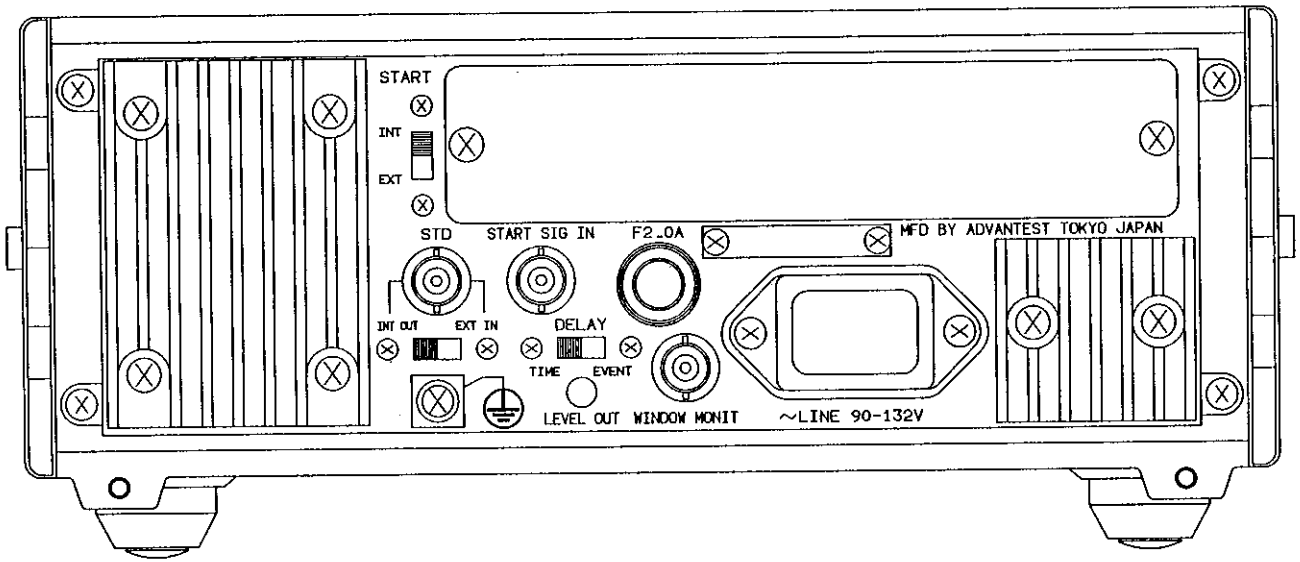
TR5835 FRONT VIEW

5835EXT4-509-A



TR5834 REAR VIEW

5834EXT5-512-B



TR5835 REAR VIEW

5835EXT6-509-A

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