INSTRUCTION MANUAL

FREQUENCY COUNTER

MODELS 253, 254

KIKUSUI ELECTRONICS CORPORATION

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

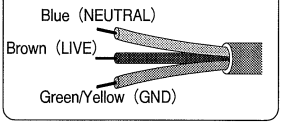
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

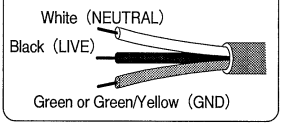
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

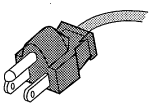
☐ Without a power plug



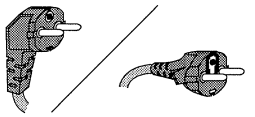
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

TABLE OF CONTENTS

1. GENERAL

Kikusui Model 253 (254) Frequency Counter is a compact and light instrument, convering a range of 10 Hz to 80 MHz.

The measured frequency is displayed on a 7-digit readout. This readout employs a blanking system to blank out the unnecessary zeros ("0" of the higher digits), for ease of reading the displayed value.

The frequency measuring unit is 0.1 Hz for gate time 10 sec, 1 Hz for 1 sec, or 10 Hz for 0.1 sec.

The measuring sensitivity is 20 mV rms. An input attenuator is incorporated for measurement of large-voltage signals without introducing counting errors.

The instrument fully employs IC's (MSI's and LSI's) and uses large LED indicator lights. The instrument is also featured with low power consumption and high operation reliability.

2. SPECIFICATIONS

Instrument name: Frequency Counter

Model No.: 253 [254]

Measured frequency range: 10 Hz ~ 80 MHz

Display: LED readout
No. of digits: 7 digits
With zero blanking system
"OVER" and "GATE" lights
Measuring unit: kHz and decimal point

Input sensitivity: 20 mV rms or over (sine wave) ... (10 Hz ~ 60 MHz)
30 mV rms or over (sine wave) ... (60 MHz ~ 80 MHz)

Attenuator: 1/1, 1/10 and 1/100

Input impedance: 1 MΩ ±10%, with 60 pF or less in parallel

Input coupling system: AC coupling, BNC terminal

Gate time: 10 sec, 1 sec and 0.1 sec; with reset switch

Measuring accuracy: Accuracy of reference signal generator ± 1 count $^{+1}_{-0}$ count

Accuracy of reference signal generator:
Aging rate: $\pm 5 \times 10^{-6}$/month
[$\pm 1 \times 10^{-7}$/month]
Temperature stability: $\pm 5 \times 10^{-6}$
($0^{\circ}C \sim 40^{\circ}C$) [$\pm 5 \times 10^{-7}$]

Maximum input voltage: 170 V .... 10 Hz ~ 40 Hz, DC + AC peak
120 V rms .... 40 Hz ~ 100 kHz
5 V rms .... 100 kHz ~ 80 MHz

Reference signal generator output:

Frequency ..... 1 MHz
Output voltage ..... TTL level, fan-out 1

Input from external reference signal generator:

Frequency ..... 1 MHz
Input voltage ..... 2.5 V rms ~ 5 V rms

Ambient temperature and humidity: 5°C ~ 35°C, 85% RH

Power requirements: 100 V ±10%, 50/60 Hz, approx. 14 VA [17 VA]
(with taps for 110 V, 117 V, 220 V, and 230 V)

Insulation resistance: 50 MΩ or over, with 500 V DC

Withstand voltage: 1000 V AC, for 1 minute

External dimensions: 200 (W) x 80 (H) x 250 (D) mm

Maximum dimensions: 220 (W) x 90 (H) x 295 (D) mm
(350 (D) mm when in carrying state)

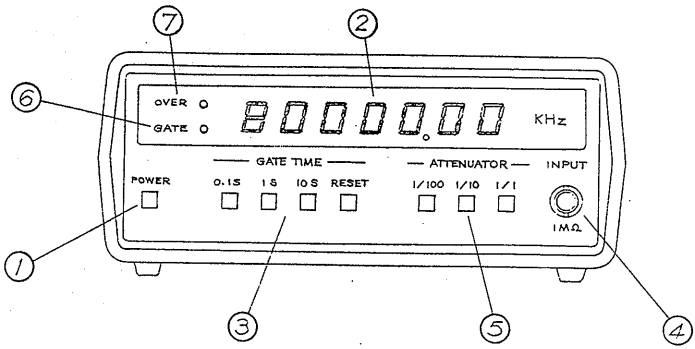
Weight (net): Approx. 2.5 kg [2.6 kg]

Accessories:

Instruction manual	1
BNC-BNC cable (about 1 meter long)	1
BNC-clip cable (about 1 meter long) ...	1

3. OPERATION METHOD

3.1 Explanation of Front Panel



① POWER switch:

For ON-OFF control of instrument power. When turned ON, the frequency readout (LED's) illuminates.

② Frequency display:

7-digit LED readout which displays the measured frequency. When no input signal is applied, the readout sisplays zeros in accordance with the set gate time as follows:

Gate time	Display
10 sec	0.0000 (kHz)
1 sec	0.000 (kHz)
0.1 sec	0.00 (kHz)

③ GATE TIME and RESET switches:

When gate time is 10 sec, resolution is 0.1 Hz.
When gate time is 1 sec, resolution is 1 Hz.
When gate time is 0.1 sec, resolution is 10 Hz.
The RESET switch is for resetting the frequency display.

④ INPUT terminal:

BNC-type connector for input signal.

⑤ ATTENUATOR switches:

Attenuate the input voltage level with a ratio of 1/1, 1/10 or 1/100.

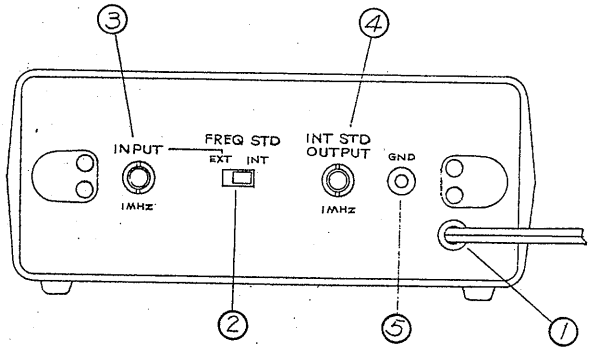
⑥ GATE TIME lamp:

Select the gate time (counting period) for 0.1 sec (0.1S), 1 sec (1S) or 10 sec (10S). The lamp is turned on for the period the gate is open, or the instrument does not count any frequency so far as none of these lamps is turned on.

⑦ OVER lamp:

An overflow indicator lamp for the frequency readout. If an input signal of 10 MHz or over is tried to be measured with the "GATE TIME" set at "1S", for example, the most significant digit cannot be displayed and the OVER lamp turns on. In such a case, change the "GATE TIME" to "0.1S" so that the value of the most significant digit can be known.

3.2 Explanation of Rear Panel



① Power cord:

AC line power input cord.

② FREQ STD switch:

Selects the reference signal (standard signal) between that of the internal reference signal generator and that of an external one. To use the internal reference signal generator, set this switch in the INT position.

To use an external signal generator which is more accurate than the internal signal generator, set this switch in the EXT position and apply the external reference signal (1 MHz) to the INPUT (1MHz) connector ③. The voltage level of the external signal should be 2.5 V rms ~ 5 V rms.

This switch is one of the items to be checked first when the instrument does not count any number in spite of that you apparently have handled the instrument correctly.

③ INPUT (1 MHz) terminal:

Apply to this terminal an external reference signal which is to be used instead of the internal reference signal.

④ INT STD OUTPUT terminal:

This terminal provides the internal reference signal (1 MHz), for external use. The output voltage level of the signal is TTL level, fan-out 1.

⑤ GND terminal:

This terminal is connected to the chassis of the instrument.

3.3 Preparations for Measurement

(1) Ensure that the POWER switch on the instrument front panel is set in the OFF state.

(2) Connect the power cord to an AC line outlet (100 V, 50/60 Hz AC).

(3) Turn-ON the POWER switch. The frequency display will turn on as explained in Item ② of Section 3.1.

(4) The instrument immediately becomes ready for use when its POWER switch is turned ON. Of the Model 254, the crystal resonator of the reference signal generator is housed in a constant-temperature oven. Allow more than 30 minutes of stabilization period after turning-ON the POWER switch.

3.4 Operating Procedure

(1) Connect the measured signal to the instrument using the cable (supplied).

(2) Set the attenuator in conformity with the measured signal voltage level. If the measured signal is predicted to be not higher than 0.2 V rms, set the attenuator in the "1/1" state; if predicted to be 0.2 ~ 2 V rms, in the "1/10" state; or if predicted to be 2 V rms or over, in the "1/100" position.

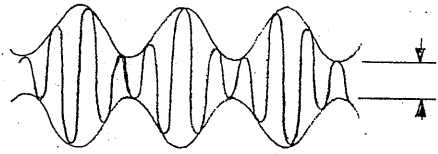
(3) Set the GATE TIME switches depending on the required measuring accuracy -- in the "10S" state for the 0.1 Hz accuracy, in the "1S" position for the 1 Hz accuracy, or in the "0.1S" position for the 10 Hz accuracy.

(4) If a signal of 1 MHz or higher is applied to the instrument with its GATE time set in the "10S" state, the most significant digit cannot be displayed as it overflows the display range. To indicate this state, the OVER lamp turns on. In such a case, set the GATE TIME in the "1S" or "0.1S" state to know the value of the most significant digit and, then, return the GATE TIME switch to the "10S" state.

Notes: Regarding the waveforms of measured signals, pay attention to the following:

(1) A triangular wave or a square wave can be measured as well as a sinusoidal wave.

(2) An amplitude-modulated wave (carrier frequency) also can be measured, provided that the minimum amplitude of the carrier wave is not smaller than the minimum measuring level. Thus, the larger the modulation degree, the larger is the required average amplitude of the measured signal.



(3) Of a frequency-modulated wave, the instrument measures the average frequency for the period during which the gate is open. Therefore, the counted values will be different for individual measurements and, thus, the frequency cannot be determined reliably.

(4) If the measured signal contains noise, set the ATTENUATOR at an appropriate range so that the errors caused by the noise can be eliminated or minimized.

(5) The input impedance of the instrument is given in terms of a parallel connection of a resistance (about 1 MΩ) and a capacitance (about 60 pF). Note that, when the input cable (supplied) is used, the capacitance becomes approximately 150 pF which may present a substantially low impedance for a high frequencies. When such large input capacitance is undesirable, a short leadwire without shielding may be used instead of the input cable supplied.

(6) Note that, when the ATTENUATOR is set in the "1/1" state, the instrument operates with a very high sensitivity. Due to this high sensitivity, the display may become unstable if the input voltage is too large or too small, the input cable is very long, the signal line is not well shielded, or grounding of the measured signal circuit is inadequate. The display may become stable by improving the measuring condition or by changing the ATTENUATOR to the "1/10" or "1/100" state.

4. OPERATING PRINCIPLE

4.1 General

The frequency (Hz) is the number of cycles per one second. Therefore the frequency can be known by counting the number of cycles per one second. The measuring principle of this instrument is shown in Fig. 3.

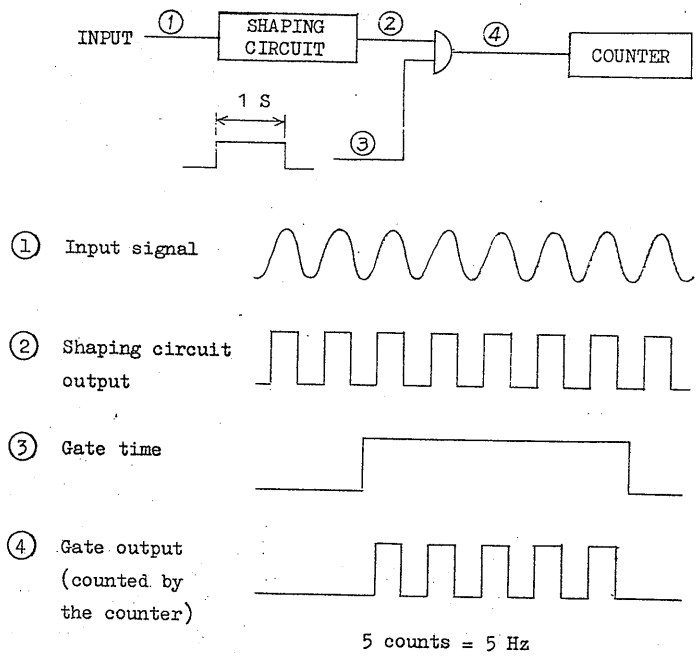


Fig. 3

4.2 Shaping Circuit

This circuit conditions the input signal into an output pulse signal of a constant amplitude and very short rise time and fall time.

For the initial state, a FET is used in a source-follower connection in order to provide a high input impedance. For the next stage, a transistor is used in an emitter-follower connection. Next, the signal is amplified with a differential amplifier by approximately 35 dB. Then the signal is conditioned into a sharp pulse signal with a pulse amplifier.

4.3 Counter Circuit

The counter circuit consists of 7 digits decimal counting stages. The readout uses 7-segment LED's and employs a dynamic illumination system for simplification of circuitry. The readout also employs a zero blanking system so that meaningless zeros of the higher digits are blanked out for ease of reading the displayed value.

4.4 Gate Time Generator Circuit

The accuracy of a frequency counter depends primarily on the accuracy of its gate time.

This instrument uses a 1-MHz crystal-controlled oscillator for generating a reference signal, which is frequency-divided to produce a gate time of 0.1 sec, 1 sec, or 10 sec. The frequency divider circuit uses LSI (MOS IC).

The 1-MHz reference signal generator is designed with full attention to ageing, temperature change, and mechanical shock and vibration.

5. MAINTENANCE

5.1 Removing the Covers

To gain access to the internal components, remove the top and bottom covers after undoing the eight clamping-screws (at both side).

5.2 Layout of Components (Adjustments)

The layout of the adjustments is shown in Fig. 4.

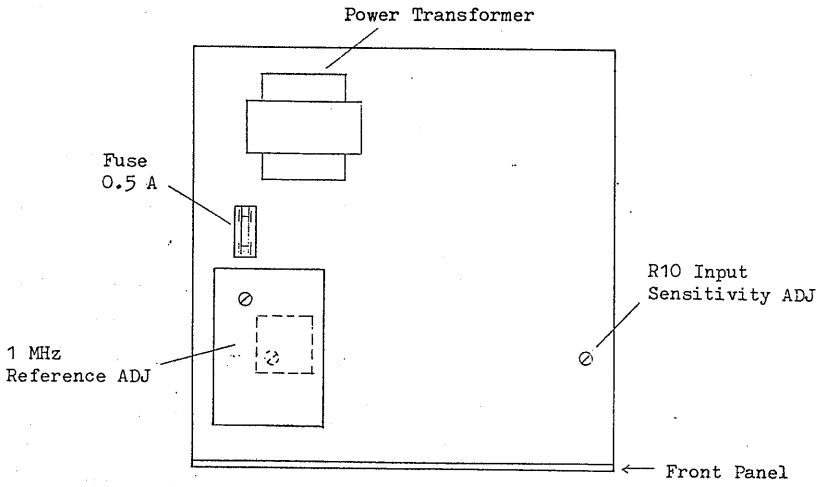


Fig. 4

5.3 Calibration of 1 MHz Reference Signal

It is recommended to calibrate the 1 MHz reference signal in every six months or thereabout. For this calibration, connect the 1 MHz output to other calibrating frequency counter (accuracy: $\pm 1 \times 10^{-8}$ or better) or other frequency calibrating device and adjust the 1 MHz Reference ADJ shown in Fig. 4. As an alternative method, apply an calibrating signal (accuracy: 1×10^{-8} or better) of a known frequency (such as with a synthesizer oscillator of 10 MHz or over), and so adjust the 1 MHz Reference ADJ that this instrument displays the corresponding frequency.

For this calibration, be sure to allow more than 60 minutes of stabilization period after turning-ON the instrument power.

5.4 Input Sensitivity Adjustment

Prepare a reference signal generator, set its frequency at 80 MHz and its output level at approximately 30 mV rms, set the ATTENUATOR in the "1/1" state, and so adjust R10 that this instrument counts the signal stably.

Note that the readout may indicate 1 count when no signal is being applied. In such a case, set R10 in the initial position where the 1 count will go off.