FREQUENCY COUNTER

USER MANUAL

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4. PANEL INTRODUCTION

(1).	Counter Input	BNC type connector.
(2).	ATT, 1/1, 1/10	Attenuation button of input sensitivity. 1/1 : Directly connect input signal to input amplifiers. 1/10: Attenuate input signal by a factor of 10.
(3).	LPF ON/OFF	Set to ON position, insert a 100kHz Low Pass Filter intc input for low frequency measurement.
(4).	FREQ/PRID	Frequency or period measurement by setting the button.
(5).	Gate Time Selector	Press the gate time button to 10 sec, 1 sec or 0.1 sec for measurement.
(6).	Power ON/OFF	Power on or off by using the button.
(7).	Gate Time(LED)	The gate time of 10 sec, 1 sec or 0.1 sec will be displayed in the LED by setting the Gate button.
(8).	Over (LED)	Overflow indicator shows that one or more of the most significant digits are not displayed.
(9).	Displayed (LED)	Display 8 digits of frequency data.
(10)	Exponent and units (LED)	LED indicator shows S and Hz of the unit and indicate the value of the measurement exponent as shown below: k=1000 M=1,000,000 G=1,000,000,000 m=1/1000 μ =1/1,000,000 n=1/1,000,000,000

- **Front Panel**

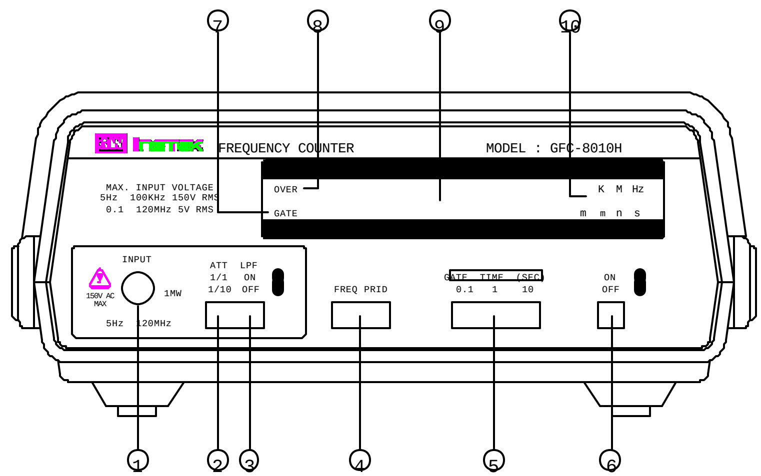

Fig. 1 Front panel

5. APPLICATION

5-1. Sensitivity

The role of the SENSITIVITY (or attenuator) switch in a common measuring instrument is to protect the input circuit and prevent the meter from going off scale.

For a counter, SENSITIVITY is still one of the large roles. Generally, hysteresis occurs in the waveshaping circuit of the counter. In order for the instrument to put up resistance to noise, the circuit will not work even when the noise is lower than the hysteresis applied. The waveshaping circuit is a Schmitt circuit and the operation of this circuit is described below:

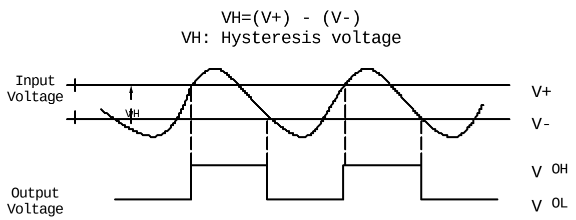

Fig. 2 Operation of the Schmitt circuit

As refer to Fig. 2, when input voltage is at V+, the output voltage is high (V_{OH}), while input voltage is at V^-, the output voltage is low (V_{OL}). The difference between these two voltage $V_H=(V^+)-(V^-)$ is called the hysteresis voltage.

But if both V^+ and V^- don't react each other, no output will be obtained and the Schmitt circuit will not work out with the states of (1), (2) and (3) of Fig. 3 shown as below.

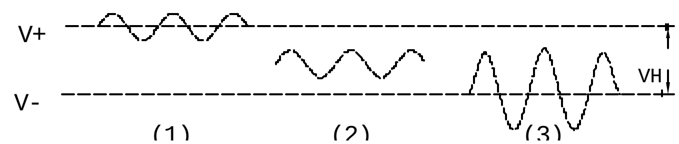

Fig. 3 States under which the schmitt circuit doesn't work

From above description, it can be easily understood whether or not the Schmitt circuit works is attributed to the SENSITIVITY (Attenuator) to determine the magnitude of the input voltage.

An example of preventing erroneous counting by correctly selecting the SENSITIVITY shown as Fig. 4 below:

(a) Correctly counting a distortion signal by selecting suitable SENSITIVITY. However, when the input voltage is too high, a frequency doubles the unknown frequency will be indicated.

(b) Erroneous counting occurs when high frequency noise is superimposed on the unknown signal and the input voltage of the Schmitt circuit is too high. However, a correct counting can be obtained by selecting suitable SENSITIVITY.

(a) When unknown signal is distorted

(b) When high frequency noise superimposed on unknown signal

Fig. 4

The erroneous counting can be prevented by satisfying two conditions below:

a) To make peak-to-peak value of the noise voltage smaller than V_H.

b) When peak-to-peak value of unknown signal is larger than V_H, perform measurements by first setting SENSITIVITY to 1/10, then set it to 1/1 range to protect the input circuit and avoid erroneous counting. One good method is to conduct measurements at the smallest possible input within the counter display value "dispersion" range. When the signal is a pure waveform, it will not occur erroneous counting with any magnit ude input lower than the input destroyed voltage.

5-2. Input Sensitivity Characteristic

The input sensitivity of this instrument is shown as Fig. 5.

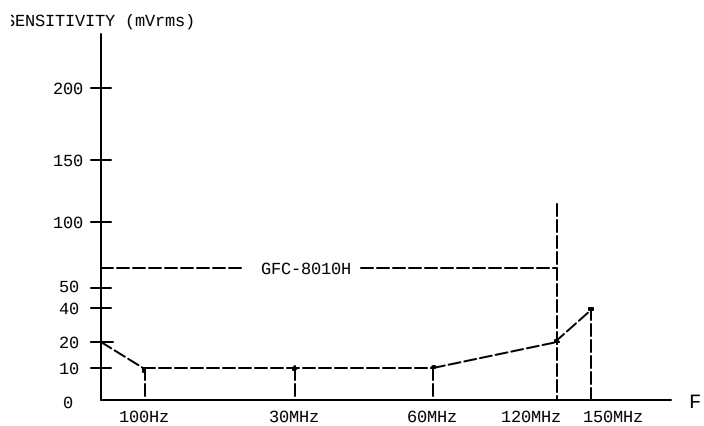

Fig. 5 Input Sensitivity Characteristic

5-3. Maximum input voltage

The maximum input voltage Vs frequency characteristics is shown as Fig. 6.

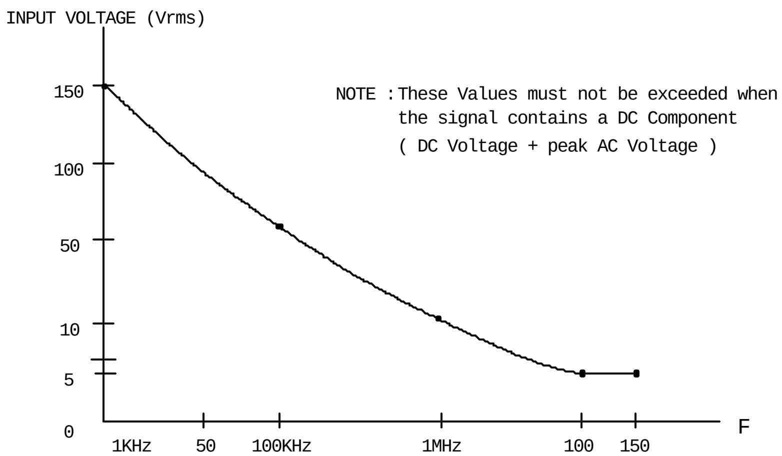

Fig. 6. Maximum Input Voltage-Frequency

5-4. Typical Applications

Several examples for typical applications are described below:

1).The output frequency of a transmitter or transceiver can be measured (if the output power is about 1W) by merely connecting a one turn clip cord to several tens of centimeters from antenna. The length of the distance is determined by the magnitude of the output.

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2).Measurement can also be easily performed when calibrating the oscillation frequency of a grid dip meter by merely connecting the one turn clip cord.

3).Measurement of tracking the frequency through the oscillator stage, multiplier stage, and output stage can be performed by making a small 2-3 turn coil and coupling it to each turned circuit (the oscillations may be produced by the input capacitance and its resonant frequency with too many turns of coil.)

Note: As the product has a high sensitivity, induction may cause erroneous counting if you touch the red end (ungrounded side) of the clip cord. Therefore, hold the black clip or coaxial cable when performing measurements according to above method.

Measurement by connecting the accessory cable directly to the test circuit is described below.

4).Measurement can generally be performed by merely connecting the black side of the clip cord to ground (GND) and the red side to the test point.

5).When the capacitance of the cable will have an affection on the test circuit (When measuring turned circuits or high output impedance circuit), perform measurement by inserting a high resistance in series with the red side of the clip cord. Always be sure to ground the cord when perform the measurement of 4) and 5) above. If possible, ground the cable to the ground point of the test circuit. This procedure will reduce the affection of noise. A wide variety of measurement can be conceived in addition to (1~5) fully utilizing the special features of the counter.

6. CIRCUIT DESCRIPTION

6-1. Theory of Operation

In order to get the most benefit from the frequency counter, it's useful to comprehend the circuit thoroughly. We have attempted every possible to utilize the latest developments in large-scale integration to provide the greatest performance for the money and, at the same time, to reduce the complexity of circuit and increase reliability.

Ignoring the prescaler for the moment, let us assume the input signal arrives at the 10MHz to 100MHz input labeled CHA in main board. This signal is first amplified by the Q201~Q202 pair. The three amplifier stages identified as U202 in the schematic are ECL logic stages biased in its linear region, each stage having a gain before feedback of about 5. A positive feedback at the output of the third amplifier when reflected through the gain of the proceeding three amplifier states (including the Q201~Q202 pair) results in about a 5mV hysteresis in the input triggering levels to aid in noise rejection. Q203 and Q204 translate the ECL levels to TTL levels. The signal is presented directly to the counter IC U301.

The IC U301 provides all the functions of the counter and display result through LED.

U201 regulates the input 9 volts signal from the line voltage transformer and rectifier circuit. When the power switch is set to "on" position, approximately 5.0 volts is applied to the circuit.

6-2. Frequency Measurement Accuracy

Measurement Accuracy

Frequency measurement accuracy is determined by the following two conditions:

1) ±1 count.

2) Time base accuracy.

The ±1 count error is inherent to digital meters and is produced by the phase relationship between the gate signal and the input signal shown in Fig. 7. The counted result of 1 count increased or decreased depends on the phase difference.

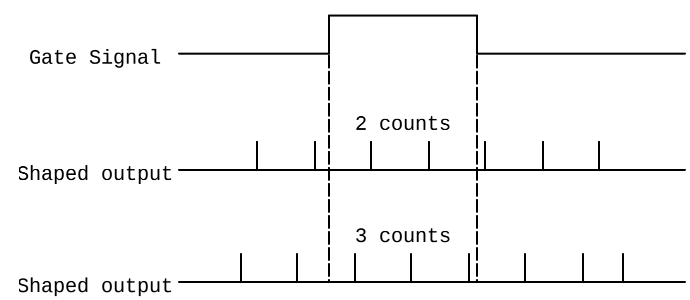

Fig. 7 ±1 count error