User's Guide

SS7402 Universal Frequency Counter/Timer/Analyzer

Suin Instruments Co., Ltd 11/2018

Introduction

SS7402 Universal Frequency Counter/Timer/Analyzer introduces high reliability and large scale integrated circuit and CPLD, the 16-bit Microchip microcontroller is used for functions control, measurement timing control, data processing and results display. With multi-cycle synchronous, reciprocal count and TDC technology combined, the measurement accuracy is improved. It has the measurement function of frequency, period, time interval, pulse width, duty cycle, count, phase difference, also with the measurement computing function such as multiple average, maximum, minimum, standard deviation, Allan Variance, a single relative deviation. Machine clock frequency is 10MHz. Not only the internal gate can realize the automatic measurement, but also the external signal trigger can control measurement. Instrument can automatically detect and convert the external frequency standard 5MHz or 10MHz. The instrument has advantages of stable performance, complete functional, wide measuring range, high sensitivity and precision, small size, nice outlook, easy to use and reliable.

Packing List

- SS7402 Frequency Counter 1
- BNC Testing Cable 1
- Power cord 1
- 1A 5×20 fuse 2
- CD 1

Options

- High-stability Crystal Oscillator 1
- 3GHz channel 1
- 6.5GHz channel 1
- 12.4GHz channel 1
- 16 GHz channel 1
- Power conditions

Content

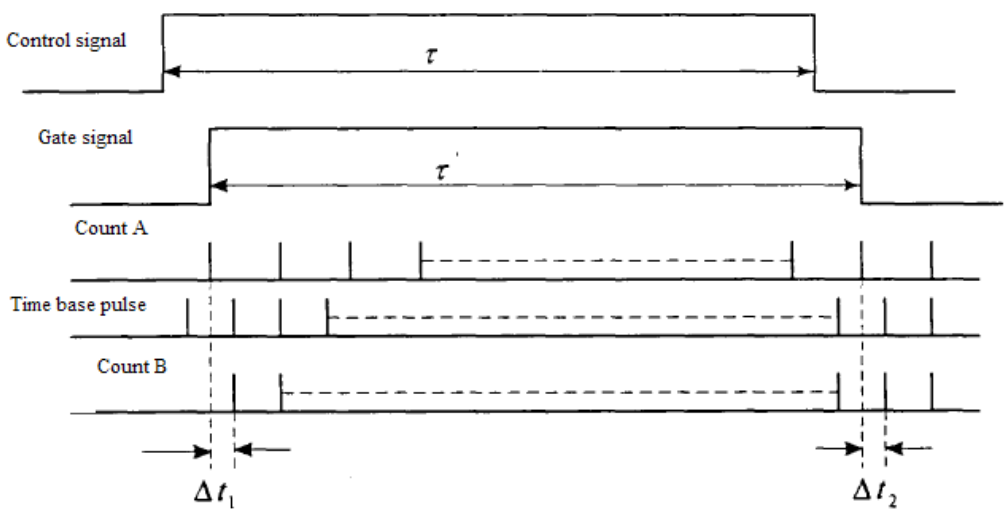
Chapter 1 Main Characteristic

- High accuracy, the measurement resolution is 11 digits /s.
- Typical resolution can reach 25ps for measurement.
- The frequency measurement of CH1 and CH2 can reach to 200MHz.
- The maximum frequency's measurement can reach to 16GHz (options)
- 16-bit microcontroller is used and the speed of data processing is fast.
- Large scale integrated circuit and CPLD and high reliability.
- With the functions of limit and mathematics for frequency measurement
- With the statistics functions of multi-average, maximum, minimum, PPM, standard deviation and Allan Variance for frequency measurement
- Standard interfaces are GPIB and RS232.
- High-stability crystal oscillator is optional.
- Comfortable vision and clarity with VFD display, small size and easy to operate

Chapter 2 Principle

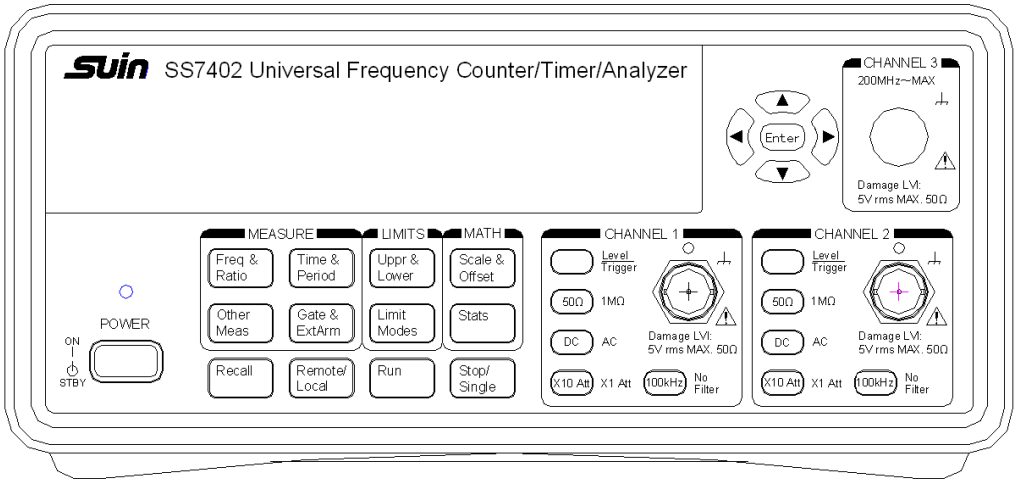
Microcontroller, the control system of counter, make all the functions available, programmed by software designers to memory, user can get desired test results followed by instructions.

The machine adopts the multi-cycle synchronous measurement method and time voltage conversion technique, shown as below picture, to count separately test signal f_x and clock pulse f_y by two registers within same gate time T, and save the counted number $X=f_x \times T$ and $Y=f_y \times T$, then get Δt_1 and Δt_2 through time digital conversion, and calculate the result of $X/(Y+\Delta t_1-\Delta t_2)=f_x$ by operation and displayed it. Here, the gate time T determined by the time controller T ' but synchronous controlled by input signal. If you set control time T' = 1s, when the first input signal open the gate, the register begin to counts for clock pulses. When up to 1s, the time controller outputs a signal to the synchronizer to close gate as next input signal arrival, and then sent the two values saved in register to computer processor for calculate and display. Due to synchronous control function (gate be synchronized with the input signal), there is no quantization error for X but Y, which could be measured through time digital conversion technique, and greatly improve resolution. The instrument's resolution is 11 bits/s. Block diagram is as follows:



Chapter 3 Panel Introduction

3.1 Front Panel



3.1.1 Introduction of interface, keys and area

〖**POWER**〗 Power Switch

【**Freq&Ratio**】Key of frequency measurement and frequency ratio measurement, when in the state of this function, LED indicator under this key will be lighted on.

【**Time&Period**】Function key of period, pulse width and time interval, the LED is the same as above.

【**Other Meas**】Function key of count, duty cycle, phase difference and voltage measurement, and indicator light is the same as above.

【**Gate&ExtArm**】Selection key of internal gate and external trigger gate, and indicator light is the same as above.

【**Upper&Lower**】To set upper limit and lower limit, and indicator light is the same as above.

【**Limit Modes**】To set limit modes, the LED lights on when select this mode.

【**Scale&Offset**】To set value and function of scale and offset, only open this function the LED will be lighted on, the default state is OFF.

【**Stats**】 Statistics operation key, the LED will be lighted on when enable this function.

【**Recall**】 Recall and Save key, also can set GPIB address and RS232 Baud rate, the LED will be lighted on when enable this function.

【Remote/Local】 Key of Remote/Local, and the default state is Local, LED is off. While, the LED is on if Remote state is selected.

【Run】 Run key, the indicator light will be on when the instruments be always on measurement state.

【Stop/Single】 Key of Stop/Single, and LED will be lighted on red when enable this function.

【Level/Trigger】 To select trigger level setting, slope, common CHA and trigger sensitivity setting, and LED will be lighted on when enable this function.

【50Ω/1MΩ】 selection key between 50Ωor high Z, light on means 50Ωand light off means 1MΩ, the default setting is high Z.

【DC/AC】 selection key of DC or AC, the default setting is AC, and LED is off; when DC is selected, LED is on.

【×10Att】 attenuation key, the default setting is no attenuation, and the LED is off; when attenuation is selected, the LED is on.

【100kHz Filter】 filter key, the default setting is no filter and LED is off; and LED will be lighted on when enable this function.

【↑】【↓】【←】【→】 Arrow keys,

【Enter】 enter key, every time you press this key the LED will be lighted on.

〖MEASURE〗 Measurement function menu keys.

〖LIMIT〗 Limit menu keys.

〖MATH〗 Math menu keys.

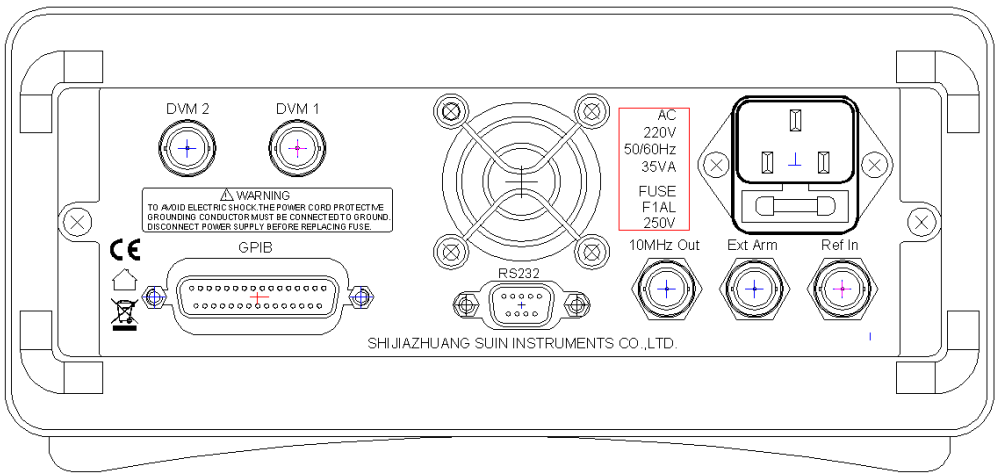
〖CHANNEL 1〗 input and state setting area of CH1, the LED above BNC connector indicates whether external signal is input.

〖CHANNEL 2〗 input and state setting area of CH2, the LED above BNC connector indicates whether external signal is input.

〖CHANNEL 3〗 signal input area of CH3.

All function key are transparent with green LED. When function enabled or disabled, the corresponding LED will be lighted on or off. Please refer to next chapter for detail descriptions.

3.2 Rear Panel



Ref In External frequency standard input, 5MHz or 10MHz can be selected, switch automatically inside the instrument.

10MHz OUT Frequency standard output 10MHz.

Ext Arm External trigger input port.

GPIB Remote interface GPIB

RS232 Remote interface RS232

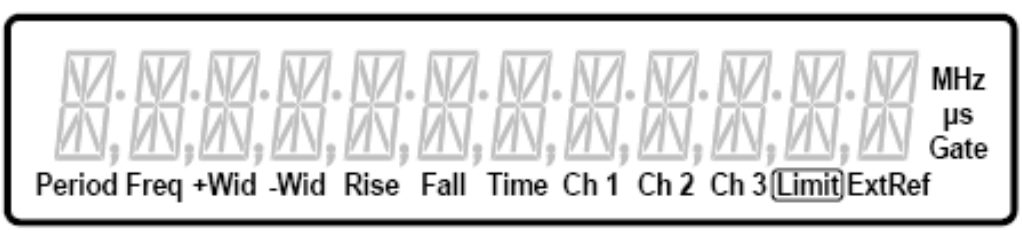
DVM1 Input port 1 of voltage measurement

DVM2 Input port 2 of voltage measurement

Outlet Power interface, with two 1A fuse, one for the spare

Note: Input ports of DVM1 and DVM2 may not be marked for some special models, which have no influence for user to use.

3.3 Display screen



Each indicator LED on position show its function as below:

Period on period measuring

Freq	on Frequency measuring
+Wid	on Positive Pulse Width measuring
-Wid	on Negative Pulse Width measuring
Rise	on Rise Time measuring
Fall	on Fall Time measuring
Time	on Time Interval measuring
Ch 1	CH1 is selected to measure an input signal.
Ch 2	CH 2 is selected to measure an input signal.
Ch 3	CH 3 is selected to measure an input signal.
Limit	on limit measuring, test value exceeds the user-entered limits.
ExtRef	reference signal using comes from Ref In input on rear panel
Hz	displayed data is in units of Hertz.
M	prefix for units of the displayed data is mega (10^6).
μ	prefix for units of the displayed data is micro (10^{-6}).
S	displayed data is in units of seconds.
Gate	gate on. Before measurement starts, this indicator is off, showing the gate off. During measuring, which will light on to indicate the gate on.

Chapter 4 Operation Instruction

4.1 Before Measuring

4.1.1 Preparation before Measuring

Please check whether the power supply and voltage within the limit range of this counter, put the power cord into the power outlet on the rear panel of this counter. **Make sure that use a three-wire power cord and two-wire power cord is forbidden. Carefully check the power condition of the test system to ensure the earthing well among systems, and make sure that instrument housings and all exposed metal are grounded. Connected with other instruments, there is no potential difference between instruments.**

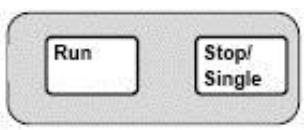
4.1.2 Power on

Press power key on the front panel, the instrument enter into initialization state, all the indicators on the front panel are ON, then display screen is full-bright, display manufacturers 'SUIN' and instrument model SS7402, and then all light off. After initialization, the instrument will enter into measuring state of Frequency1. Default state is Local.

Note: Warm-up 30 minutes at least before the instruments running so as to guarantee each modular circuit and crystal oscillator be in stable status, otherwise the measurement result will be affected.

4.2 Operation Instruction

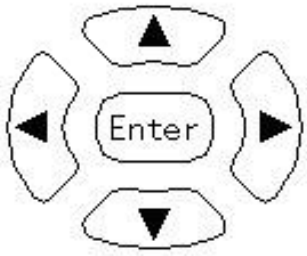
4.2.1 【**Stop/Single**】and 【**Run**】keys



Press【**Run**】 key to constantly measure with LED indicating, press 【 **Stop/Single** 】 key to stop or make single-shot measurements. When switch from Run to Stop/Single, it displays the last read value, and the red light under button will light on. Once you press the Stop/Single key, it will read again and update the display with red indicator blinking once.

Under counting function of 【**Other Meas**】**,** for Run state, the indicator of 【**Other Meas**】and 【Run】will be light on at the same time, the display shows the counting value. If press 【**Stop/Single**】key, the indicator of 【**Run**】will light off, while the indicator of 【 **Stop/Single** 】will light on, showing the final count value, then press again the 【**Stop/Single**】key and counting start again, the indicator blink once, press again the count will stop, display the final value and the red indicator light on.

4.2.2 **【Enter】**, **【↑】**, **【↓】**, **【←】**, **【→】** key

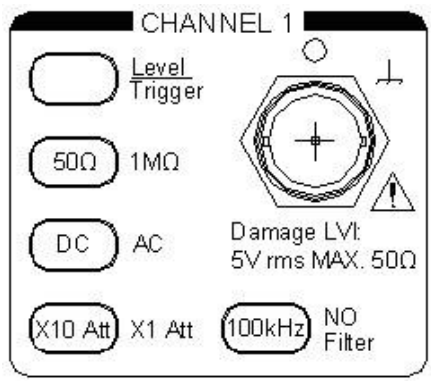


Press **【→】** to move right to select adjustable digits or adjustable menu.

Press **【←】** to move left to select adjustable digits or adjustable menu.

Press **【↓】** to decrease the selected digit of the displayed value.

Press **【↑】** to increase the selected digit of the displayed value. Also it can be used to select the adjustable menu in some function (like **【←】** key**)**.



4.2.3 Channel setting area

1) Press**【Level/Trigger】**key, indicator lights on and displaying LEVEL OFF and auto sampling and set trigger level mode will be turned off. Then use the **【↑】【↓】【←】【→】**keys to open the auto trigger level and press **【 Enter 】** to confirm the current operation.

If turn off the auto trigger level, press the **【Level/Trigger】** again, 'LEVEL: xx.xxxV' will display. Then use the **【↑】【↓】【←】【→】** key to adjust trigger level, finally press **【Enter】** key to confirm and exit **【Level/Trigger】** function.

Press **【Level/Trigger】** key again, the function is switched to polarity selection, SLOPE:POS or SLOPE:NEG will be shown in the display and the LED indicator will be on. Use **【↑】【↓】【←】【→】** keys to select Positive or Negative, finally press **【Enter】** key to confirm.

For channel 1, press**【 Level/Trigger 】** key third times and enter into the function of common channel 1. Default setting is COMMON A: OFF. Use **【↑】【↓】【←】【→】** keys to enable or disable this function. Finally press**【Enter】** key to confirm the operation.

The fourth time you press**【 Level/Trigger 】** key, the function is switched to trigger sensitivity setting. The default is medium scale of trigger sensitivity and 'SENSITIVE:MID' displays. Use **【↑】【↓】【←】【→】** key to select 'HIGH' and 'LOW', finally press **【Enter】** key to confirm.

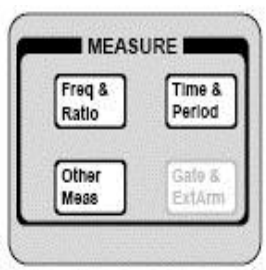
2) Use 【**50Ω/1MΩ**】key to select 50Ω or 1MΩfor channel, and the default setting is High Z 1MΩ. Press this key and the indicator light on , the counter be in 50Ω, press this key again then switch to 1MΩ and the indicator light off.

3) Use the 【**DC/AC**】key to select the AC or DC. The default setting is AC and the indicator is off. Press this key to switch to DC and indicator on.

4) 【**×10Att**】is attenuation key. The default setting is ×1 attenuation state and the indicator is off. Press this key the state will be switched to ×10 attention and the indicator on.

5) 【**100kHz Filter**】is filter key. The default setting is non-filter and the indicator is off. Press this key and the state will be switched to 100kHz filter and the indicator on.

4.2.4【**Freq&Ratio**】,【**Time&Period**】,【**Other Meas**】



All measurement functions are realized by these three keys. Use 【**Freq&Ratio**】to measure the Frequency and Frequency Ratio of CH1, CH2 and CH3. Use 【**Time&Period**】key to measure Period, pulse width (Postive or Negative) and time interval. And use 【**Other Meas**】key to measure count, duty cycle, phase difference and voltage.

Please refer to below table to see detailed functions,

【**Freq&Ratio**】	【**Time&Period**】	【**Other Meas**】
FREQUENCY 1	PERIOD 1	COUNTER 1
FREQUENCY 2	PERIOD 2	COUNTER 2
FREQUENCY 3	PERIOD 3	DUTYCYCLE 1
RATIO 1 TO 2	TI 1 TO 2	PHASE 1 TO 2
RATIO 1 TO 3	POS WIDTH 1	DVM
RATIO 2 TO 1	NEG WIDTH 1	
RATIO 3 TO 1		

To sequence through the menus of the measurement function keys【**Freq&Ratio**】, 【**Time&Period**】and【**Other Meas**】you simply need to repeatedly press the appropriate MEASURE key to cycle through (and loop around) the menus under the key. Each press of a MEASURE key will advance the Counter to the next measurement function in the menu.

1) To Measure Frequency

a. Connect power source to Counter, and turn on Counter.

b. Connect an input signal to CHANNEL 1.

To set up trigger level, signal polarity, coupling, impedance, and other triggering conditions to match the input signal need to measure, which can be set by pressing key of **【100kHz Filter】**,**【×10Att】**,**【DC/AC】**,**【50Ω/1MΩ】** and **【Level/Trigger】**.

c. Press the **【Freq&Ratio】** key until **FREQUENCY 2** is displayed to measure the frequency of an input signal applied to CHANNEL 2. FREQUENCY 2 is momentarily displayed, the **Freq** and **Ch2** indicator light, and the Counter is ready to measure frequency of a signal applied to CHANNEL 2 input.

2) To Measure Frequency Ratio

Press **【Freq&Ratio】** key until **RATIO 1 TO 2** is displayed.

RATIO 1 TO 2 is momentarily displayed, the **Freq, CH1**, and **CH2** indicator light, and the Counter is ready to measure and display the frequency ratio of a signal inputted to CHANNEL 1 in relation to a signal applied to CHANNEL 2 (CH1/CH2), that result will be displayed as decimal, not percentage. Default setting of CH1 and CH2 is positive; gate time 1s and trigger level 0V, and the measure mode can be switched by function menu keys.

Note that **RATIO 2 TO 1** is also available (CH2/CH1), detailed operation same as **RATIO 1 TO 2**

By pressing **【Freq&Ratio】** key again, the Counter will return to the Frequency 1 measurement mode, which shows the loop around feature of the measurement function menu keys.

3) To Measure Period

Press **【Time&Period】** key until **PERIOD 1** is displayed.

PERIOD 1 is momentarily displayed, the **Period** and **CH1** indicator light, and the Counter is ready to measure the period of a signal applied to CH1.

Press the key again until **PERIOD 2** is displayed and counter come into the measurement sate of CH2, the state and operation as same as CH1. The operation of CH3 period measurement is same as above, it can be neglected if channel option is not selected for CH3.

4) To Measure Time Interval

Press **【Time&Period】** key until **TI 1 TO 2** is displayed and counter come into the measurement state. A signal applied to CH1 is worked as start signal and a signal applied to CH2 is worked as stop signal. The time difference between two signals is displayed and the **Time, CH1** and **CH2** indicator light. Press **【Level/Trigger】** key to set the trigger slope of start or stop signal to be positive or negative.

5) To Measure Pulse Width

Press 【**Time&Period**】 key to choose **POS WIDTH 1** or **NEG WIDTH 1** as user desired, which will be momentarily displayed, then enter into current measurement of pulse width on CH1 and display it, the **+WIDTH** or **-WIDTH**, and **CH1** indicator light. Note that the pulse width measurement automatically configures the Counter to perform positive or negative pulse width measurements through CHANNEL 1 input.

6) Count

Press 【**Other Meas**】 key until **COUNTER 1** is displayed. the **CH1** indicator lights, and the Counter1 is momentarily displayed and enter into totalize function, to display the value calculated within current gate time as changing of length of gate time. Also external gate time is available to select.

When first time to press 【**Run**】or【**Stop/Single**】**,** the counting will be cleared and restart to count.

The screen displays **COUNTER 2** when pressing 【**Other Meas**】key again, the result from this function is the accumulation count value at CH2.

7) To Measure Duty Cycle

Press【**Other Meas**】key until **DUTYCYCLE 1** is displayed. **DUTYCYCLE 1** is momentarily displayed, the **CH1** indicator lights. The duty cycle mode of operation is ready to measure a continuous waveform applied to CHANNEL 1 input. Then current duty cycle value will be shown in display and GATE flash once every time you measure gate. Results will range from 0 to 1. This function is only available for CH1.

8) To Measure Phase Different

Press【**Other Meas**】key until **PHASE 1 TO 2** is displayed. **PHASE 1 TO 2** is momentarily displayed, the CH1 and CH2 indicator light, and the Counter is ready to measure the phase of a signal applied to CH1 input relative to a signal applied to CH2 input. The phase difference is displayed in degrees. However, you may disable auto triggering, and change the trigger levels and slopes.

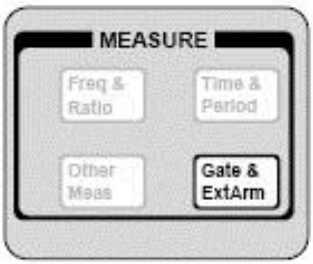
Signal on CH2, as the reference, one cycle of which is defined to be 360 °.

9) To Measure Voltage

Press【**Other Meas**】key until **DVM1 DVM2** is displayed. **DVM1 DVM2** is momentarily displayed and counter is ready to measure, current value of DVM1 and DVM2 is displayed. The unit is 'V'. When facing the counter, the left-hand side displays the voltage value of DVM1 while right-hand side displays the voltage value of DVM2, both can be measure and

display at the same time. Use【**Recall**】key to select the range of DVM1 and DVM2, including 20V, 2V and AT (auto), of which the detail, please refer to menu introduction of 【**Recall**】, and 20V range is the default setting.

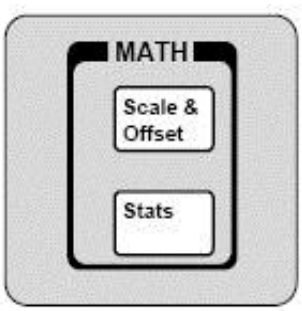
4.2.5【Gate&ExtArm】key



The SS7402 has two arming modes: Internal and External. Press 【**Gate&ExtArm**】key until 1.000000 is displayed and the indicator light. Use 【↑】and 【↓】to increase and decrease values of current digit, use【←】and 【→】to select digit needed to be adjust and specified range is 0.000001s to 1000s. After selecting, press【**ENTER**】to confirm. Then the counter return to previous measurement menu and continue measuring. The sign GATE on screen will blink frequently as the gate time.

Press【**Gate&ExtArm**】key again in the menu until **GATE:EXTERNL** is displayed thus the indicator light, and the **EXTERNL** is blinking. When external arming mode is enabled, a signal must be connected to the Counter's rear-panel Ext Arm connector, then press 【**ENTER**】key to confirm the current operation.

4.2.6【Scale&Offset】and【Stats】key



Math and Limits are not available for Count and self-check measurements. As shown in left diagram, the keys of 【**Scale&Offset**】and 【**Stats**】are included in **MATH** function area. The **MATH** function is disabled in the initial state and the indicator of the two keys are OFF.

1) The function of 【Scale&Offset】key

The Scale and Offset functions within the Math menu allow you to perform simple mathematical operations on the measurement result before it is displayed. Modification of the displayed measurement by these math operations is represented by the following equation:

(Measurement × Scale) + Offset = Displayed Result

The math operations have many uses, for example, to subtract systematic errors and so on. The menu items of the Scale and Offset Math functions:

a. enter a desired multiplication factor SCALE for a measurement.

b. enter a desired addition or subtraction value OFFS for a measurement.

c. disable or enable the Math mode. The initial state is **MATH:OFF**. Make sure to turn the Math mode on if you want to make this function enable.

Example Procedure for Scale and Offset, see the below:

a. Input a signal to CH1, press【**Freq&Ratio**】key to measure Frequency of CH1.

b. Press【**Scale&Offset**】key and **MATH:OFF** is displayed, press any arrow key the MATH:ON is always displayed and the indicator light.

c. Press 【**Scale&Offset**】again, and SCAL:1.000000 is displayed. The scale value doesn't need to be set in this example. If need, use arrow key to set SCAL value.

d. Then pres【**Scale&Offset**】again and OFFS:0.000000 is displayed. Because of systematic errors 1Hz, use arrow key to set offset value be 1Hz, and OFFS:-1.000000 is displayed.

e. Press【**ENTER**】key to confirm the operation and the counter begin to measure, measured result will multiply 1 and subtract 1 (systematic error 1Hz), then display the final one.

Note: If you turned MATH off, no matter you set SCAL of OFFS, the MATH operation doesn't work. But if you set SCAL or OFFS then press 【**ENTER**】and back to previous measure state, the MATH mode will be opened automatically and the indicator of 【**Scale&Offset**】 light.

2)【Stats】key

All the statistical computation function under this key is only applicable to CH1 frequency measurement.

a. Press 【**Stats**】key until **SHOW:MEAN** is displayed, the indicators of Freq and CH1 light.

b. Use the arrow key to select desired function, such as **MEAN, MAX, MIN, PPM, STD DEV and ALLAN.**

- Averaged value MEAN: after 'N' Measurement

  $$\text{MEAN}=\frac{1}{N}\sum_{i=1}^{N} Fi$$

- Maximum value MAX: after 'N' Measurement

  MAX= the maximum value during 'N' measurement.

- Minimum value MIN:

  MIN= the minimum value during 'N' measurement.

- Signal relative deviation measurement （PPM ACCURACY）:

$$\text{PPM}=\frac{Fi-Fo}{Fo}\times 10^{6}$$

- Standard deviation measurement (STD DEVIATION):

$$\text{STD DEV}=\sqrt{\frac{N\sum_{i=1}^{N}Fi^{2}-(\sum_{i=1}^{N}Fi)^{2}}{N(N-1)}}$$

- Allan Variance Measurement（ALLAN VARIANCE）:

$$\text{ALLAN}=\sqrt{\frac{\sum_{i=1}^{N-1}(F_{i+1}-F_{i})^{2}}{2(N-1)}}$$

'N' in above formula is sampling time, F_0 is pre-set frequency, F_i is measured frequency.

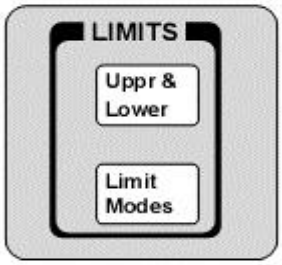
Press any arrow key until **SHOW:MAX** is display if you want use MAX function.

c. Press 【**ENTER**】key to confirm the current operation, the indicator flash once and the counter is ready to measure and **DOING STATS** is displayed. The default sample number N is 100 and trigger gate time is 1s. The maximum value is displayed after 'N' measurement. If you want to restart to select the computing function, press 【**ENTER**】key again then back to function menu.

d. Press 【**Stats**】again until **F_0:10.000000** is displayed, the indicator of unit M is light. F_0 is pre-set frequency which is applied to PPM ACCURACY. Press arrow key to adjust the pre-set frequency. Use 【↑】and【↓】key to increase or decrease the current value and the step value is 1. Use 【←】and【→】key to shift the digits left or right. Press 【**ENTER**】key to confirm, otherwise, it isn't a valid operation.

e. Press 【**Stats**】key again until N:100 is displayed. N is sample number, and it's minimum number is 2 and maximum number is 999999. In current menu, use 【↑】and【↓】key to increase or decrease the current value and the step value is 1. Use 【←】and【→】key to shift the digits left or right. Press 【**ENTER**】key to confirm, otherwise, it isn't a valid operation.

4.2.7 【**Uppr&Lower**】and【**Limit Modes**】key



LIMIT menus are not available for Count and self-check function.

The menu items under the Limits keys allow you to:

1) Select the desired upper and lower measurement limits (UPPR:, LOWR:).
2) Disable or enable Limit Testing (LIM TEST: OFF or ON), and Limit Testing is automatically enabled when you set the upper and lower limits.
3) Set the run mode when a measurement exceeds the user-entered limits: continue or stop measuring (**ON FAIL: GO ON** or **ON FAIL: STOP**).

For example: to measure a signal frequency whether within the setting limits, suppose the frequency of the signal is 10MHz. Now the operation begins:

a. Connect input signals to channels 1 of the Counter, the indicator blink.
b. Press【 **Freq&Ratio** 】key to set the measuring for CH1 frequency, displays **FREQUENCY 1**, the counter is ready to measure and the current frequency value is displayed.
c. Press【**Uppr&Lower**】key until UPPR:********* is displayed.
d. Set upper frequency by arrow keys, and set the frequency to be 11.000000MHz.
   Note: make sure to press 【**ENTER**】key to confirm after setting upper limits.
f. Set lower limits frequency to be 9.000000MHz by using arrow keys and make sure to press 【**ENTER**】key to confirm after setting.
g. Press 【**Limit Modes**】key until **LIM TEST:ON** is displayed and press 【**ENTER**】 to confirm.
   Note that the Limit Testing is automatically enabled when you set the upper and lower limits. But to guarantee the function, please turn on the limits function again after setting upper and lower limits.
h. Press【**Limit Modes**】key again until **ON FAIL:GO ON** is displayed. Adjust **ON FAIL: STOP** by using any arrow key. Press【**ENTER**】key to confirm.
i. Press 【**Freq&Ratio**】key or 【**Run**】key and the counter is ready to measure. If the measurement result exceeds the user-entered limits, the indicator of **LIMIT** will light.

4.2.8 【**Recall**】and【**Remote/Local**】key

1) Under【**Recall**】key, the following functions are included: storage, recall, cancel store, crystal oscillator state, GPIB interface address and RS232 Baud rate, self-calibration, voltage measurement range selection, calibrating bytes of voltage measurement, VCXO voltage setting, etc.. The instrument displays **RECALL: 0** when pressing the key for the first time, it enters into **SAVE** function when pressing the key again, with UNSAVE, MS OVEN, GPIB address, RS232 Baud Rate, auto calibration, voltage measurement range selection, calibration bytes of voltage measurement and VCXO setting function menus followed, under which the users could set current function with the direction keys, where the setting of GPIB address ranges from 1 to 30, confirm the operation with the 【**ENTER**】key finally. There are 15 memory locations for save and recall measuring state. **MS OVEN:000** represents that the instrument use High-stability Crystal Oscillator internally at present, while **MS OVEN:001** represents that the instrument use common crystal oscillator internally at present.
Under 'AUTO CAL' state, this menu is served as calibrating menu for system parameters. Make sure that counter warm-up half of hours at least if users want to calibrate for system parameters. No input signal and press 【**ENTER**】key twice, then the counter can finish the parameters calibration automatically and end with **CAL DONE** displaying. Finally press 【**ENTER**】again to store the calibration result and the counter will work with the new calibrating data when power on the counter next time. If the system can't finish the auto calibration after a long time, then user can reboot the counter and repeat above operation until the calibration finish.
Under menu 'SCALE: 20 20', it's used to select the voltage range of DVM1 and DVM2, both default setting is 20V range. If the 20 is blinking, which means the DVM2 range can be set through 【↑】【↓】to select '2' (2V range) or 'AT' (auto range). Use 【←】【→】key to select DVM1 or DVM2. Finally press 【**ENTER**】key to confirm the current operation.
Press 【**Recall**】key again to enter into calibrating byte menu, and the calibrating steps are as below,
A. Prepare one set DC power supply to work as standard;
B. The screen displays 'CAL BYTE 1：00', please connect the power output with DVM1 and set the power output to be 0V;
C. Then press the 【**ENTER**】key, '00' on the screen is blinking fast, press 【**ENTER**】key to store the calibrating bytes until it stops blinking.

D. Press【↑】key and 'CAL BYTE 1：01' displays. Set the output of DC power supply to be 18V to DVM1. Press【**ENTER**】key and the '01' is blinking, press【**ENTER**】key to confirm the current operation until it isn't blinking.

E. Press【↑】key and 'CAL BYTE 1：02' displays. Connect reference 0V to DVM1, press【**ENTER**】key until '02' stop blinking, press【**ENTER**】key to confirm the current operation.

F. Press【↑】key and 'CAL BYTE 1：03' displays. Connect reference 1.8V to DVM1, press【**ENTER**】key until '03' stop blinking, press【**ENTER**】key to confirm the current operation.

G. Press【↑】key and 'CAL BYTE 1：04' displays. Connect reference 0V to DVM2, press【**ENTER**】key until '04' stop blinking, press【**ENTER**】key to confirm the current operation.

H. Press【↑】key again and 'CAL BYTE 1：05' displays. Connect reference 18V to DVM2, press【**ENTER**】key until '05' stop blinking, press【**ENTER**】key to confirm the current operation.

I. Press【↑】key again and 'CAL BYTE 1：06' displays. Connect reference 0V to DVM2, press【**ENTER**】key until '06' stop blinking, press【**ENTER**】key to confirm the current operation.

J. Press【↑】key again and 'CAL BYTE 1：07' displays. Connect reference 1.8V to DVM2, press【**ENTER**】key until '07' stop blinking, press【**ENTER**】key to confirm the current operation.

K. The DVM calibration is finished after performing above eight steps. The DVM function is debugged well and store the relative calibrating bytes. Therefore, users are not suggested to operate it unless necessary situations.

Press【**Recall**】key again to enter into VXCO setting menu and 'VXCO VOLT' displays in the initial screen. This function is used to calibrate VXCO of inner crystal oscillator. Make sure that connect the external clock meeting certain specification to CH1 on the front panel, at same time the screen shows measured frequency of reference clock and user can adjust the voltage by pressing【↑】【↓】【←】【→】in current menu.【←】and【→】keys are rough adjusting and convenient to use if the deviation of two clocks is larger.【←】is used to increase value while【→】to decrease value.【↑】and【↓】keys are

fine adjusting and convenient to use if the deviation of two clocks is smaller. 【↑】is used to upper deviation while 【↓】is used to lower deviation. Use both of rough tuning and fine tuning to make the measurement result more closer to the truth value of clock reference. Finally press the 【**ENTER**】to confirm the current operation and store the voltage value, which will be recalled automatically when power on next time.

Press 【**Recall**】key again to enter into manual setting menu of level offset , which is designed for setting of CH1 and CH2. Users do not operate this menu, it is only obligated for debugging staff. Therefore, users are not suggested to operate it unless necessary situations.

Press 【**Recall**】key again to enter into trigger sensitivity menu of CH1 and CH2, separately is the setting of CH1 and CH2, which is the debug menu reserved for debugger, so users are forbidden to operate this area.

In addition, if users change current state without confirming the operation by【**ENTER**】key, the instrument will keep its setting before the adjustment.

2) Initial state of the counter is local, the indicator of【**Remote/Local**】is OFF. Press 【**Remote/Local**】key until **REMOTE** or **LOCAL** is displayed. **REMOTE** displayed and the indicator light show current remote state. Except of【**Remote/Local**】key, other keys are disable and only remote operation are enable. Press【**Remote/Local**】key again until **LOCAL** is displayed and the indicator is OFF. At present the counter is in **LOCAL** state and can be operated by local key.

Chapter 5 Remote Instruction

5.1 Summary

Programmer commands for the counter are written by referring to SCPI standards. And standard interface of RS232 and GPIB are supportable for this counter. The programmer commands are based on ASCII code, the data that counter return to computer are also ASCII code, through the remote interface to programmer control the instruments.

5.2 Connection and setting of interface

RS232 interface of this instrument is universal serial one with 9-pin socket, which can be connected with computer by standard RS232 cable. Make sure to power off when connecting. Press【**Recall**】key to set the parameters (Baud rate)of RS232 interface. The default serial port is 8 bit, one stop bit, no odd-even check.

If the commutation between computer and counter is not available, please check Baud rate setting whether they are in line. Change baud rate if necessary, to adjust the configuration of PC serial port.

Connect the computer with counter by IEEE488 cable to and make sure to power off before connecting. Press【**Recall**】key to set the remote control address .

The initial state is LOCAL when power on. Once enter into REMOTE state, the other keys on front panel are disable except of【**Remote/Local**】key. Press 【**Remote/Local**】key under remote state to enter into LOCAL state manually.

5.3 Introduction of Programmer commands

5.3.1 SCPI commands structure

There are two commands types for this counter: GPIB common commands and SCPI commands (Commands Standard of Programmable Instruments). GPIB common commands, definite with IEEE488.2-1987 standards, applied to all instruments, but this counter doesn't support all the common commands. SCPI command, with tree structure, has three levels at most, and top one is called subsystem command. Only select the subsystem command, the sub-level under this command can be effective. Colon **:** is used to separate high-level commands and low-level commands.

5.3.2 SCPI commands grammar

a) Command keywords and parameter

There are two types for common commands and SCPI commands: parameter and no parameter. Here are some examples:

*RST no parameter

:FORMat<name> parameter (name)

:IMMediate no parameter

There must be one space at lease between keywords and parameter.

- Some command words in [ ]:, which means these commands are optional, and allow not to be contained. '[ ]' means the contents in the sign is optional, please don't add [ ] when sending commands. For example:

  :RANGe [:UPPer] <n>

  [:UPPer] means :UUPer is optional and allow not be used. So this command can be also sent with:

  :RANGe <n> or :RANGe:UPPer <n>

But for the number 1 and 2 in the next commands,

[:SENSe]:EVENt[1|2]:SLOPe?

If '1|2' in the [ ] is omitted, this commands is default as [:SENSe]:EVENt1:SLOPe?. But if users want to set CH2, the 2 in the [ ] is must to be included.

Note: When optioned commands are selected, please don't use [ ].

- < > : indicates parameter type, should not written when program or sending commands. For example: :HOLD:STATe <b>

  <b> means here is a Boolean parameter. If you want to use HOLD function, commands with On or 1 must be sent, see below:

  :HOLD:STATe ON or :HOLD:STATe 1

- Parameter type: here are some common parameters types:

  <b> Boolean: enable or disable some operation function by using this parameter. 0 (OFF) means to turn off this operation and 1(ON)means to turn on the operation. For example:

  :INPut1:FILTer ON turn on filter function of CH1

  <name> Name parameter: select one in the listed parameter, for example:

  <name> = MOVing

  REPeat

  :RESistance:AVERage:TCONtrol MOVing

  <NRf> Numeric Representation format: this represents an integer(4), real (42.4) or float number (4.24E3). For example:

  :EVENt1:LEVel:ABSolute 4.24

<n> Numeric value: This parameter value represents the NRf number or name of these parameters are as follows:
DEFault, MINimum, MAXimum.

b) Rules for commands keyword

Use the following rules to determine any SCPI command abbreviations.

- If the length of keywords is less than or equal to four characters, there is no abbreviations. For example:

  :AUTO = :AUTO

  The rules is applied to keywords exceeds four characters.
- If the forth character of key words is one of v,o,w,e and l, remove it together with following charaters. For example:

  :immediate = :imm
- Special rules: this abbreviations format is only selected first two characters of the keyword:

  :Tcouple = :tc
- If the forth character in the keyword is a consonant, then remain it and remove following charanters. For example,

  :format = :form
- If the command contains the query (?), or a non-selected numbers, which must be keep in abbreviations. For example:

  : delay? =: del?
- Keywords or signs included in square brackets ([ ]) are optional, which can't be included in the programming code.

c) Basic rules of command structure

- Ignore block letters or lowercase.

  For example, FUNC:IMP CPD = func:imp cpd = Func:Imp CpD
- Space (_ stands for space) should not be put in back or front of colon.
- Abbreviation or full format of command are both ok (block letters must be used in abbreviation format)
- Add an interrogation "?" in the end of commands, you can query the current value for this command.

d) Multi-command rules

Use semicolon (;) to separate the multi commands at the same level.

- For multi commands, semicolon (;) is used to spate the level commands under same subsystem.
- Semicolon (;) as a separator, followed by a colon (:), means re-start to command from the top level of the command tree.
- As long as using a semicolon (;) to separate the common commands and SCPI commands, they can be used in the same command.

e) Command path rules

- Each new program must begin with the root command, unless the root command is optional (for example: [SENSe]). If the root command is optional, make the next level of command as root command.
- The colon (:) at the start of program is optional, you can select it or not. For example: : INITiate [: IMMediate] = INITiate [: IMMediate]
- When the program detects a colon (:), the program pointer moves to the next command level.
- When the program detects a colon (:) followed by a semicolon (;), it will return to the root command level.
- The procedure pointer can only move down to lower level, not move up to higher level, so the instrument will restart from the root command when it need to run one higher level command.

5.3.3 Programmable command format

Programmable command is the commands that computer send to counter and be based on ASCII characters. The end command is 0AH (LF or hex ten). Note: the counter need a certain time to response one command sent by computer, only after this, second command sending is allowed.

5.4 Programmer commands

Here will introduce the remote commands the counter will use in detail and some requirements:

1. To set/inquiry trigger level
   [:SENSe]:EVENt[1|2]:LEVel[:ABSolute] <numeric_value>[V]
   [:SENSe]:EVENt[1|2]:LEVel[:ABSolute]?
2. To set/inquiry trigger slope
   [:SENSe]:EVENt[1|2]:SLOPe POSitive | NEGative
   [:SENSe]:EVENt[1|2]:SLOPe?
3. To set/inquiry input impedance

:INPut[1|2]:IMPedance <numeric_value> [OHM]

:INPut[1|2]:IMPedance?

4. To set/inquiry coupling state

:INPut[1|2]:COUPling AC|DC

:INPut[1|2]:COUPling?

5. To set/inquiry attenuation ×1

:INPut[1|2]:ATTenuation 1

:INPut[1|2]:ATTenuation?

6. To set/inquiry attenuation ×10

:INPut[1|2]:ATTenuation 10

:INPut[1|2]:ATTenuation?

7. To set/inquiry Filter swtich

:INPut[1|2]:FILTer ON | OFF

:INPut[1|2]:FILTer?

8. To set/inquiry Baud rate

:SYSTem:COMMunicate:SERial:TRANsmit:BAUD <numeric_value>

:SYSTem:COMMunicate:SERial:TRANsmit:BAUD?

9. To set/inquiry Stop or Signal

:INITiate:CONTinuous OFF

:INITiate:CONTinuous?

10. To set/inquiry Run at full speed

:INITiate:CONTinuous ON

:INITiate:CONTinuous?

11. Begin to measure

:INITiate[:IMMediate]

12. To enquiry present measurement function

[:SENSe]:FUNCtion[:ON]?

13. To measure frequency

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]FREQuency [1 | 2 | 3]"

14. To measure frequency ratio

[:SENSe]:FUNCtion[:ON] FREQuency:RATio [1,2 | 1,3 | 2,1 | 3,1]

15. Count

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]TOTalize [1|2]"

16. To measure phase difference

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]PHASe [1,2]"

17. To measure duty cycle

    [:SENSe]:FUNCtion[:ON] "[:][XNONe:]DCYCle [1]"

18. To measure time interval

    [:SENSe]:FUNCtion[:ON] "[:][XNONe:]TINTerval [1,2]"

19. To measure period

    [:SENSe]:FUNCtion[:ON] "[:][XNONe:]PERiod [1,2]"

20. To measure positive pulse-width

    [:SENSe]:FUNCtion[:ON] "[:][XNONe:]PWIDth [1]"

21. To measure negative pulse-width

    [:SENSe]:FUNCtion[:ON] "[:][XNONe:]NWIDth [1]"

22. To set/inquiry External gate trigger

    [:SENSe]: ARM:SOURce EXTernal

    [:SENSe]: ARM:SOURce?

23. To set/inquiry gate time

    [:SENSe]:ARM:TIMer <numeric_value> [S]

    [:SENSe]:ARM:TIMer?

24. To set/inquiry Slope in time interval

    [:SENSe]:TINTerval:ARM:STARt:SLOPe POSitive | NEGative

    [:SENSe]:TINTerval:ARM:STARt:SLOPe?

25. To set/inquiry Slope in time interval

    [:SENSe]:TINTerval:ARM:STOP:SLOPe POSitive | NEGative

    [:SENSe]:TINTerval:ARM:STOP:SLOPe?

26. To set/inquiry upper limit

    :CALCulate2:LIMit:UPPer[:DATA] <numeric_value> [HZ | S | DEG

    :CALCulate2:LIMit:UPPer[:DATA]?

27. To set lower limit

    :CALCulate2:LIMit:LOWer[:DATA] <numeric_value> [HZ | S | DEG]

    :CALCulate2:LIMit:LOWer[:DATA]?

28. To set/inquiry Limit state ON/OFF

    :CALCulate2:LIMit:STATe OFF | ON

    :CALCulate2:LIMit:STATe?

29. To set/inquiry ON FAIL:GO ON

    :INITiate:AUTO OFF

:INITiate:AUTO?

30. To set/inquiry ON FAIL:STOP

:INITiate:AUTO ON

:INITiate:AUTO?

31. To set/inquiry Statistics computation

:CALCulate3:AVERage:TYPE MAXimum | MINimum |SDEViation | MEAN |ALLan|PPM

:CALCulate3:AVERage:TYPE?

32. To set/inquiry N value

:CALCulate3:AVERage:COUNt <numeric_value>

:CALCulate3:AVERage:COUNt?

33. To set/inquiry SCALE

:TRACe[:DATA] SCALE <numeric_value>

:TRACe[:DATA] SCALE?

34. To set/inquiry OFFSET

:TRACe[:DATA] OFFSET <numeric_value>

:TRACe[:DATA] OFFSET?

35. To set/inquiry Math function ON/OFF

:CALCulate:MATH:STATe OFF | ON

:CALCulate:MATH:STATe?

36. To set/inquiry F0

:CALCulate3:AVERage:F0 <numeric_value>

:CALCulate3:AVERage:F0?

37. To readout the current value

FETC?

38. To get the model and version of the counter

*IDN?

39. Reset

*RST

40. Read frequency: also can get frequency value when measuring Period

:FETCh[:FREQuency]?

41. Read period: also can get period value when measuring Frequency

:FETCh[:PERiod]?

42. Read frequency ratio

:FETCh[:FREQ:RAT]?

43. Read phase difference

:FETCh[:PHASe]?

44. Read duty cycle

:FETCh[:DCYCle]?

45. Read time interval

:FETCh[:TINTerval]?

46. Read positive pulse-width

:FETCh[:PWIDth]?

47. Read negative pulse-width

:FETCh[:NWIDth]?

48. To set/inquiry GPIB address

:SYSTem:COMMunicate:GPIB:TRANsmit:ADDRess <numeric_value>

:SYSTem:COMMunicate:GPIB:TRANsmit:ADDRess?

Except of frequency and period, 9.100000000E+037 will be returned if users want to read the tested value under non-present function. And it's not available to read test value under count function.

5.5 Introduction of programmer commands

The initial state of the counter is local, but it will enter into the remote state when sending commands to the counter by using remote interface. The baud rate of RS232 in initial state is 9600, and the remote address of GPIB is 15, which can be modified by using the keys on front panel or programmer commands. In the process to remote control the counter, the counter will automatically run the commands as it's correct, and fail to run it once the sending command is wrong.

Concerning to the unit of commands, they are all the international standard units, if you input wrong units the counter won't recognize. If using a piece of remote commands including unit, the unit can be input or ignored.

If the commands including data, there are two ways to input, for example, 10000 is equivalent to 1e4, 0.00234 is equivalent to 2.34e-3. The data that instrument return are all expressed in scientific notation.

Chapter 6 Service and Support

Warranty

For the technical and material's defects of the products that Shijiazhuang Suin Instruments Co., Ltd produced and sold, we promise one year warranty since the shipment day. During the warranty, to the defective products which is proved, we will regroup or replace this defective ones based on the detailed provisions of the warranty

Except guarantees of this outline and warranty, we factory make no any other forms of expressed or implied guarantees at all. In any case, we factory bear no responsibility with those direct, indirect or any other consequential loss.

Contact us

If you have any inconvenience during the use of this product, please contact our company directly:

Monday to Friday,8:00-17:00 GMT

Tel: +86-311-83897147

Email: export@suintest.com

Website: http://www.suintest.com

Chapter 7 Specification

7.1 Working Environment

Temperature: 0 ~ +40℃

Relative Humility: 20~90%

7.2 Input Characteristic

7.2.1CH1 & CH2

Frequency range:	DC coupling	0.001Hz ~200 MHz
	AC coupling	1MHz~200 MHz (50Ω On)
	AC coupling	30Hz~200 MHz (1MΩ On)
Dynamic Range:	50mVrms~1.0Vrms (Sine)	
	$150mV_{P-P}$~$4.5V_{P-P}$ (Pulse)	
Input impedance:	1MΩ//35pF or 50Ω	
Coupling mode:	AC or DC	
Trigger Mode:	rise edge or fall edge	
Input attenuation:	×1 or ×10	
Low-pass Filter:	Ending frequency is around 100 kHz	
Trigger level:	-5.000V~+5.000V, min. step 1mV or auto trigger level	
Trigger sensitivity:	High, Middle, Low	
Damage Level:		
	50Ω	5Vrms
0 ~ 3.5kHz	1MΩ	350Vdc + ac pk
3.5kHz ~100kHz	1MΩ	350Vdc + ac pk，when linearity fall to 5Vrms
> 100kHz	1MΩ	5Vrms

7.2.2 CH3

1) Option 1

Frequency range:	100MHz~3GHz
Dynamic Range:	-27dBm~+19dBm Sine
	(Frequency: 100MHz~2.6GHz)
	-15dBm~+19dBm Sine
	(Frequency: 2.6GHz~3GHz)
Input impedance:	50Ω
Coupling mode:	AC

2) Option 2

Frequency range: 200MHz ~ 6.5GHz

Input sensitivity: ≤-15dBm

Max. input power: +13dBm

Damage level: +20dBm

3) Option 3

Frequency range: 6.5GHz ~12.4GHz

Input sensitivity: ≤15dBm (Typical Value)

Max. input power: +10dBm (typical value: +13dBm)

Damage level: +25dBm

4) Option 4

Frequency range: 6.5GHz ~16GHz

Input sensitivity: ≤-15dBm(Typical Value)

Max. input power: +10dBm (Typical value: +13dBm)

Damage level: +25dBm

5) Option 5

Frequency range: 200MHz~12.4GHz

Input sensitivity: ≤-15dBm(Typical Value)

Max. input power: +10dBm (Typical value: +13dBm)

Damage level: +25dBm

7.2.3 External-gate input

Signal input range: TTL level

Pulse width: ≥50ns

External-gate signal: Positive pulse

7.3 Time Base

7.3.1 Internal crystal oscillator

Nominal frequency: 10MHz

	Common crystal oscillator(001)	High stability crystal oscillator(000)
Factory accuracy	Better than 5×10^{-8}	Better than 5×10^{-8}
Aging rate	1×10^{-8}/day	5×10^{-10}/day

Note: Around 15 minutes are needed to boot up the counter before operating, so as to warm up time base in advance and get a stable working state to make sure long term reliability. Additionally, the crystal oscillator

comes up with voltage controlled port and can be adjusted the accuracy through 【**Recall**】key, please refer to 【**Recall**】instruction for detail.

7.3.2 Time base input

Frequency: 5MHz or 10MHz

Waveform: Sine

Amplitude: ≥1V_{P-P}

7.3.3 Time base output

Frequency: 10MHz Sine

Amplitude: ≥1V_{P-P}

7.4 DVM input

Measurement range： ±1.999 VDC or ±19.99 VDC

Input impedance： 1 MΩ

Accuracy： 0.6 % of full range

Range ： 20V, 2V and Auto

Measurement speed： 10 ms

7.5 Measurement index

7.5.1 Frequency measurement

CH1 and CH2 range: 0.001Hz~200MHz

CH3 range: 100MHz~16GHz (refer to options specifications)

Measurement error:

$$< \pm\left(\frac{100\text{ps typ.}[350\text{ps max.}]}{\text{Gate}} + \text{Timerbase Error}\right) \times \text{Frequency}$$

Gate time: 0.000001s ~ 1000s, step 0.000001s, external gate is optional

Least significant digits (LSD):

$$\frac{\text{Freq} \times 10\text{ps}}{\text{Gate}}$$

max. frequency resolution: 1μHz

7.5.2 Period measurement

CH1 range: 5ns~1000s

CH2 range: 5ns~1000s

Measurement error:

$$< \pm\left(\frac{100\text{ps typ.}[350\text{ps max.}]}{\text{Gate}} + \text{Timerbase Error}\right) \times \text{Period}$$

Gate time: same as frequency measurement

7.5.3 Time interval and pulse width measurement

Input signal through CH1, CH2 within whole range between CH1 and CH2

Measurement range: 1ns~10000s

Least significant digits: single sample 10ps and 4ps under average conditions

RMS Resolution:

Standard time base: $\sqrt{\frac{(25\text{ps typ.}[75\text{ps max.}])^2+(0.2\text{ppb}\times\text{Interval})^2}{N}}$

Optional high stable crystal oscillator: $\sqrt{\frac{(25\text{ps typ.}[75\text{ps max.}])^2+(0.05\text{ppb}\times\text{Interval})^2}{N}}$

Note that 'N' is sampling number.

Measurement error:

$$< \pm(500ps\ typ.[1.5\text{ns max.}] + \text{Timerbase Error} \times \text{Inteval} + \text{Trigger Error})$$

Trigger Error:

$$\frac{(15\text{mV} + 0.5\% \times \text{trigger level of setting}) \times 2}{\text{Input Slew Rate}}$$

Input slew rate means the slew rate of input signal at the setting trigger level.

For the measurement for two trigger points (such as time interval and pulse width), the trigger error includes independent the starting trigger error and the stopping trigger error.

7.5.4 Frequency ratio measurement

Ratio range: 0.00001~999999

Least significant digits (LSD):

CH1 / CH2: $\frac{1}{Fre\ of\ CHB \times gate\ time}$

7.5.5 Duty cycle measurement

Input signal within whole range of CH1

Requirement: pulse width $\geq$ 20ns, period<1000s, the smaller pulse width is, the bigger the error is.

Duty cycle measurement range: 1~99%

7.5.6 Count measurement

Measurement range: $0 \sim 1\times10^{13}$

Gate time: same as frequency measurement

7.5.7 Phase-difference measurement

Definition: Phase = 360 ×(Tb – Ta) / Period A

Measurement range: 1°~+359°, 1mHz-100MHz

Gate time: the measurement for period A uses system gate and the setting is same as frequency measurement. The measurement of time interval only measure the processing time.

Measurement error: $< \pm(1\ ns \times Freq \times 360 + 0.01)°$

7.5.8 Upper/lower limit operation

Display mode: the indicator 'Limit' will light on when result beyond the upper/lower limit, but light off when result within the upper/lower limit.

7. 5.9 Statistics operation (frequency measurement)

Statistics function: multi-average, maximum, minimum, single relative deviation (PPM), standard deviation, Allan variance

Display: multi-average, standard deviation, Allen variance LSD= single/N

LSD of single relative deviation =single$\times 10^6/F_0$, the unit is PPM, LSD of other function will remain.

Sampling time: 2~1000000

7.6 General Characteristics

7.6.1 Remote programmable interface

GPIB and RS232 (standard)

7.6.2 Power conditions

	Standard:	Optional:
Voltage:	AC220V ($1\pm10\%$)	AC110V ($1\pm10\%$)
Frequency:	50Hz ($1\pm5\%$)	60Hz ($1\pm5\%$)
Power:	<70VA	<70VA

7.6.3 Dimensions: $375\times105\times235(mm)^3$ Weight:5.2kg