User's Guide

SS7301 Frequency Counter

Shijiazhuang Suin Instruments Co., Ltd 05/2012

Introdction

SS7301 Frequency Counter 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. Also uses reciprocal counting techniques and TDC (Time to Digital Conveter) techniques to improve the measurement accuracy. It has the measurement function of frequency, period, frequency ratio, etc., also with the measurement computing function such as multiple average, maximum, minimum, standard deviation, Allan Variance, a single relative deviation. Machine clock frequency is 100MHz. Measurements can automatically measure the internal gate, by an external signal trigger control measure. Instrument can automatically detect the external frequency standard 5MHz or 10MHz. The instrument performance is stable, fully functional, wide measuring range, high sensitivity, high precision, small size, beautiful appearance, easy to use and reliable.

Packing List

- SS7301 Frequency Counter 1
- BNC Testing Cable 1
- Power cord 1
- 1A 5×20 fuse 2
- CD 1

Options

- GPIB interface 1
- 3GHz channel 1
- 6.5GHz channel 1
- 12.4GHz channel 1
- 16 GHz channel 1
- High-stability Crystal Oscillator 1

Content

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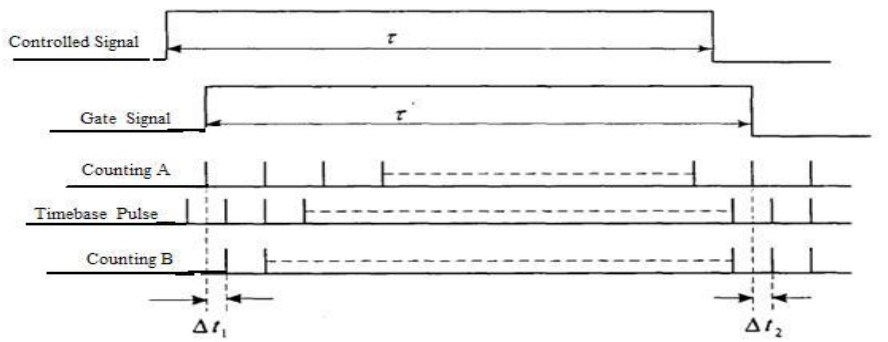
Chapter 1 Main Characteristic

- High accuracy, the resolution is 10 digits /s.
- single resolution can reach 500ps.
- The frequency measurement of CH1 can reach to 200MHz.
- The maximum frequency's measurement can reach to 16 GHz (optional)
- 16-bit Microchip 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 average, maximum value, minimum value, PPM, standard deviation and Allan Variance for frequency measurement
- Standard interface is USB and RS232, GPIB is optional.
- High-stability crystal oscillator is optional.
- Comfortable vision and clarity with 12 bits VFD display

Chapter 2 Principle Summary

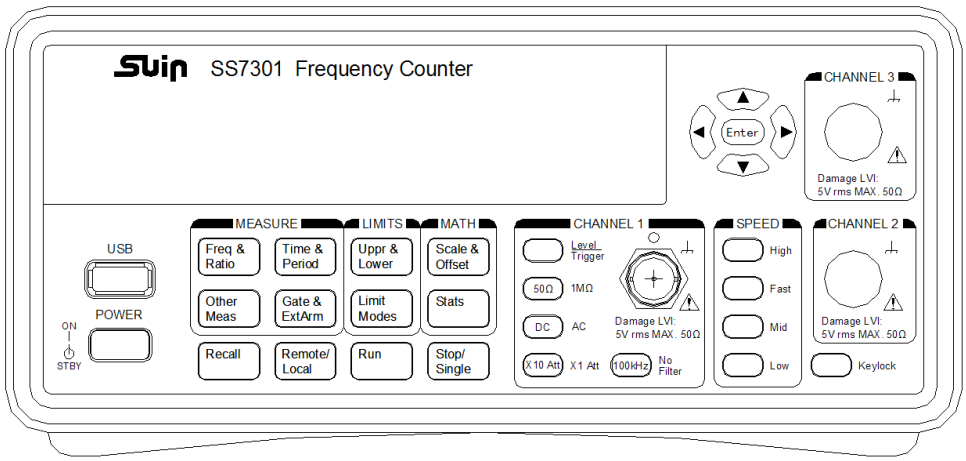
This instrument make microcontroller as the command of the whole system, all of the functions are pre-programmed by software designers to a memory, user can get ideal test results as long as you operate following the instructions.

The machine adopts the inverse multi-cycle synchronous measurement method timing-digits conveting techniques shown as follow. To count sepeartely test signal f_x and clock pulse f_y with two registers within same gate time T, and storage down counted number $X = f_x * T$ and $Y = f_y * T$, and meantime to obtained Δt_1 and Δt_2 through TDC, get $X/(Y+\Delta t_1-\Delta t_2)=f_x$ then displayed. Here, the gate time T determined by the time controller T ' but synchronous controlled by input signal. If you choose control time T' = 1s, when the first input signal open the gate, the register begin to counts for clock pulses. When up to the equivalent of 1s, the time controller outputs a signal to the synchronizer so as to make gate closed when the next input signal arrival, and then sent two register's values to computer processor to be calculated then display. As the synchronous control function (gate be synchronized with the input signal), there is no quantization error for X but Y do exist quantization error, quantization error of Y can be measured by TDC method. Therefore, the instrument's resolution is more precise than ever. This instrument resolution is 10 bit / s or 11 bits/ 10s. Block diagram is as follows



Chapter 3 Panel Introduction

3.1 Front Panel



3.1.1 Introduction of each interface, pressing-key and subarea

〖**POWER**〗Power Swtich

〖**USB**〗 USB interface

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

【**Time&Period**】Function key of period, the LED is the same as above.

【**Other Meas**】Function key of frequency self-test, 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, only limit mode is open the LED will light on.

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

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

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

【**Remote/Local**】Key of Remote and 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 and Single, and LED will be light on and be red when execute this function.

【**Level/Trigger**】Function switch between trigger level and slope, and LED will be light on and be red when execute this function.

【**50Ω /1MΩ**】slection key between 50Ω or 1MΩ, light on means 50Ω and light off means 1MΩ, the default setting is high impedence.

【**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 unattenuation, and the LED is off; when attenuation is selected, the LED is on.

【**100kHz Filter**】filter key, the default setting is unfilter and LED is off; press this key again the filter is started and the LED is on.

【**High**】 speed testing: high, internal is 10ms gate, select it the LED will on.

【**Fast**】speed testing：fast, internal is 100ms gate, select it the LED will on.

【**Mid**】 speed testing：middle, internal is 400ms gate, select it the LED will on.

【**Low**】speed testing: low, internal is 1s gate, the default setting, select it the LED will on.

【↑】【↓】【←】【→】 Arrow keys,

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

〖**MEASURE**〗Measurement function menu keys.

〖**LIMIT**〗Limit menu keys.

〖**MATH**〗Math menu keys.

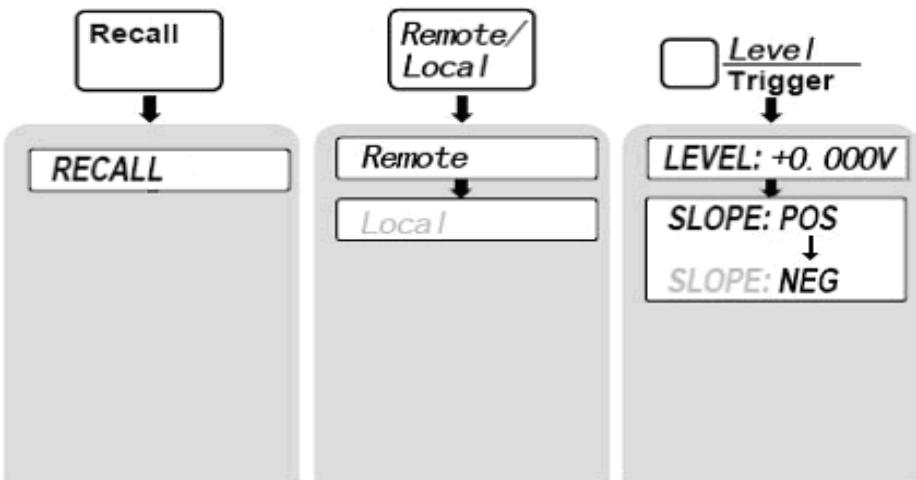
〖**SPEED**〗testing speed area .

〖**CHANNEL 1**〗input and state setting area of CH1, the LED above Q9 interface stands that whether the external signal is input.

〖**CHANNEL 2**〗input and state setting area of CH2.

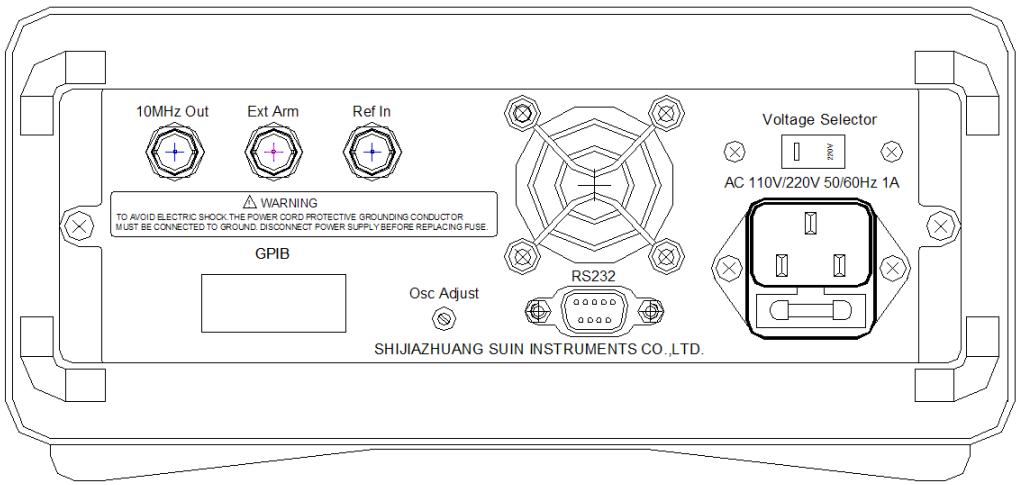
〖**CHANNEL 3**〗signal input area of CH3.

3.1.2 Function of each key



All function keys are transparent with green LED under. 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.

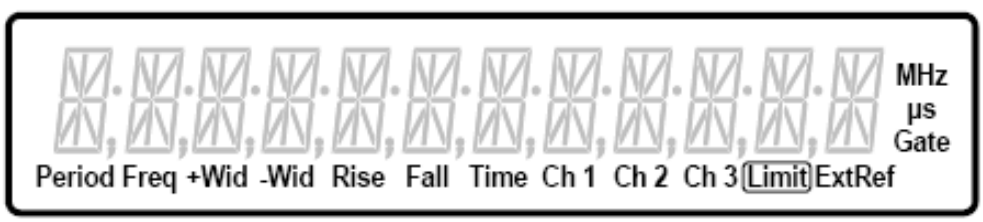
Ext Arm External trigger input port.

GPIB Remote interface GPIB

RS232 Remote interface RS232

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

3.3 Display Annunciators



Period Counter is set to measure Period

Freq Counter is set to measure Frequency

+Wid Counter is set to measure Positive Pulse Width

-Wid Counter is set to measure Negative Pulse Width

Rise Counter is set to measure Rise Time

Fall Counter is set to measure Fall Time

Time Counter is set to measure Time Interval

Ch 1 Counter's channel 1 is selected to measure an input signal.

Ch 2 Counter's channel 2 is selected to measure an input signal.

Ch 3 Counter's channel 3 is selected to measure an input signal.

Limit Counter is limit testing and the current measurement exceeds the user-entered limits.

ExtRef Counter is set to use the signal connected at rear panel Ref In connector as the frequency standard signal

Hz The displayed data is in units of Hertz.

M The prefix for the units of the displayed data is mega (10^6).

μ The prefix for the units of the displayed data is micro (10^{-6}).

S The displayed data is in units of seconds.

Gate The gate is open. Before a measurement starts, this annunciator is OFF, indicating the gate is closed. During a measurement, the annunciator is ON, indicating the gate is open.

Note: Above mentioned states are not completely applicable for this instrument.

Chapter 4 Operating Instruction

4.1 Works before Measurement

4.1.1 Preparation before Measurement

4.1.1.1 Check the completeness of the counter and its accessories based on the package list. If the packing box is damaged badly, please keep it till the counter passes the performance test.

4.1.1.2 Power on the instrument only under the following conditions.

Voltage: 1. AC220 (1±10%) V Frequency: 50 (1±5%) Hz

2. AC110（1±10%）V Frequency: 60（1±5%）Hz

Power consumption: <35VA

Temperature: 0 ~ 40℃

Humidity: 20 ~ 90%

Carefully check whether the power supply and voltage within the limit range of this counter, put the power cord into the power outlet in the rear panel of this counter. Make sure 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 between systems is no problem, and make sure instrument housings and all exposed metal are grounded. Connected with other instruments, there is no potential difference between instruments.

4.1.2 Power on

After connecting power, internal crystal oscillator of the counter is already power on.

Press power switch in the front panel, the instrument enter into initialization state, First of all display screen is full-bright, display manufacturers 'SUIN' and instrument model SS7301, all the indicators in the panel are flash once.

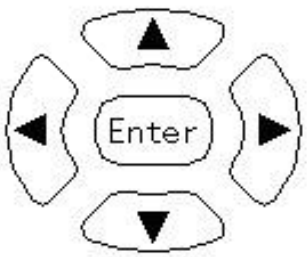
After initialization, the instrument will enter into measurement state of Frequency1. The default is the local state. The test speed is Low.

4.2 Operation Instruction

4.2.1 【Stop/Single】and 【Run】keys

In general, the Run key provides repetitive Measurement while the Stop/Single key allows you to stop the current measurement or make single-shot measurements. When switch from Run to Stop/Single, the display shows the last read value, and the red ligh under this key begin to light. At present, every time you press the Stop/Single key, the counter will read the value again and update the display. Meantime, the red indicator under Stop/Single key will light on once.

4.2.2 【Enter】、【↑】、【↓】、【←】、【→】 key



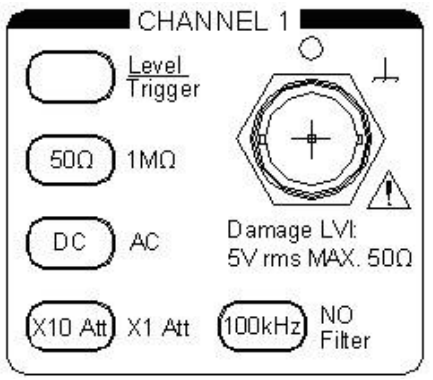
Use the 【→】 to move right to select adjustable digits or adjustable menu.

Use the 【←】 to move left to select adjustable digits or adjustable menu.

Use the 【↓】 to decrement the selected digit of the displayed value. Also it can be used to select the adjustable menu in some function. (same as【→】)

Use the 【↑】 to increment the selected digit of the displayed value. Also it can be used to select the adjustable menu in some function. (same as 【←】)

4.2.3 Setting key in Channel selection



1) 【Level/Trigger】key, press this key the indicator light on and the 'LEVEL:+0.000V' will be shown in the display, the value is adjustable. Then use the 【↑】【↓】【←】【→】key to adjust the trigger level and press 【Enter】to confirm, and out of this function at present. Press this 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 【↑】【↓】

【←】【→】key to select in the Positive and Negative, finally press 【Enter】 key to confirm.

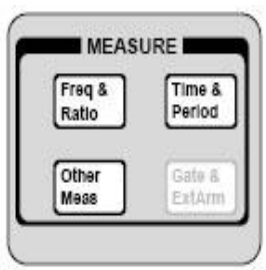
2) Use 【50Ω /1MΩ 】key to select the chanel state to be 50Ω or 1MΩ , and the default setting is high impedance 1MΩ . Press this key fitst time and the indicator light on , the counter be in 50Ω , press this key again then switch to 1MΩ and the indicator light off.

3) Use the 【DC/AC】key to selec the AC or DC. The default setting is AC and the indicator is off. Press down this key, the state be switched to DC and indicator is light 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 swith to ×10 attention and the indicator is ligh 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 switch to 100kHz filter and the indicatot is on. Press this key again at present state will be switch to non-filter again.

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



All measurement functions of this counter are included in the three keys. Use 【Freq&Ratio】to measure the Frequency and Frequency Ratio of CH1 and CH2. Use 【 Time&Period 】 key to measure Period, pulse width(Postive or Negative) and time interval. And use 【Other Meas】key to measure totalize, duty cycle and phase difference.

For the detail function description of three keys, please see the below table,

【Freq&Ratio】	【Time&Period】	【Other Meas】
FREQUENCY 1	PERIOD 1	FREQ CHECK
FREQUENCY 2	PERIOD 2	
FREQUENCY 3		
RATIO 1 TO 2		
RATIO 1 TO 3		
RATIO 2 TO 1		
RATIO 3 TO 1		

To sequence through the menus of the measurement function keys (Freq & Ratio, Time & Period, and Other Meas keys), 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 CHANNEL 1's trigger level, signal polarity, coupling, impedance, and other triggering conditions to match the input signal you are trying 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 Ch2annunciators light, and the Counter is ready to measure frequency of a signal applied to CHANNEL 2 input.

d. Press the 【Freq&Ratio】key until FREQUENCY 3 is displayed to measure the frequency of an input signal applied to CHANNEL 3. FREQUENCY 3 is momentarily displayed, the Freq and Ch3annunciators light, and the Counter is ready to measure frequency of a signal applied to CHANNEL 3 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 annunciators light, and the Counter is ready to measure and display the frequency ratio of a signal applied to CHANNEL 1 in relation to a signal applied to CHANNEL 2 (Ch1/Ch2).

Note the result is not scaled by 100; it is not a percentage.

Note that the default setting of CH1 and CH2 is positive, gate time 1s and trigger level 0V, and the measure mode can be switch by function menu keys.

Note that RATIO 1 TO 3 is also available (Ch1/Ch3). And operation is same as RATIO 1 TO 2.

By pressing the Freq & Ratio key, the Counter will execute RATIO 2 TO 1 and RATIO 2 TO 1 one by one then return to the Frequency 1 measurement mode; this demonstrates 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 annunciators light, and the Counter is ready to measure the period of a signal applied to CH1.

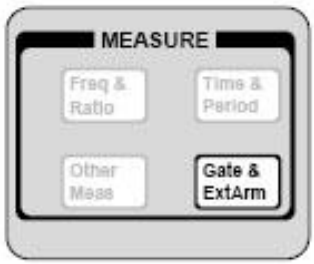
Press the key again until PERIOD 2 is displayed and conter come into the measurement sate of CH2, the state and operation as same as CH1

The state and operation of PERIOD 2 as same as above mentioned.

4) Frequency Check

Press 【Other Meas】 key until Frequency Check is displayed. The Ch1 annunicators light, and values regarding to 10MHz clock will be shown in T type Display.

4.2.5 【Gate&ExtArm】key

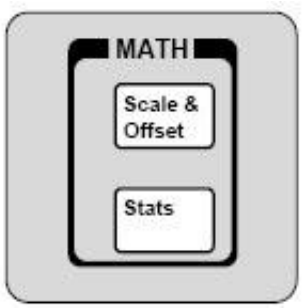


The SS7200A has two arming modes: Internal and External.

Press 【Gate&ExtArm】key until GATE:1.000s is displayed and the annunicators light. Use 【↑】, 【↓】, 【←】and 【→】to select gate, and the optional gate is 1000s、100s、10s、7s、4s、1s、700ms、400ms、100ms、70ms、40ms、10ms、7ms、4ms、1ms、100μs、10μs. After selecting, press 【ENTER】to confirm. Then the counter back to the previous measurement menu and continue measuring.

Press this key again in the 【Gate&ExtArm】menu until GATE:EXTERNL is displayed thus the annunicators light, and the EXTERNL is in flash state. 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



Note that Math and Limits are not available for Totalize 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 annunicators 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 can be used, for example, to subtract systematic errors and

so on.

The menu items of the Scale and Offset Math functions allow you to:

a. enter a desired multiplication factor for a measurement (SCAL:).

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

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. Connect a signal to channel 1, 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 annunicators 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 press 【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 mearsure, the displayed result is measured result multiply 1 then subtract 1(systematic error 1Hz)

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 annunicators 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 annunciators of Freq and CH1 light.

b. Use the arrow key to select the required 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.

Singal 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 formular is sample number, F_0 is pre-setting frequency, F_i is measured frequency.

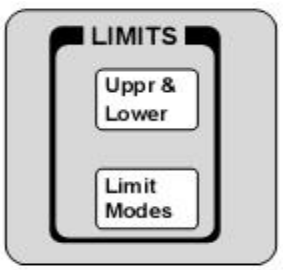
Press any arrow key until SHOW:MAX is display if you want use MAX function.

c. Press 【ENTER】key to confirm the current operation, the annunciators 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 maxmum value is displayed after 'N' measurement. If you want to restat to select the computing function, press 【ENTER】key again then ao back to function menu.

d. Press 【Stats】again until F_0:10.000000 is displayed, the anunciators of unit M is light. F_0 is pre-setting frequency which is applied to PPM ACCURACY. Press arrow key to adjust the pre-seting 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 unitl N:100 is displayed. N is sample number, and it's minmum number is 2 and maxmum number is 10000. 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



Note: Limis menus are not available for Totalize and self-test measurements.

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)—Note that the Limit Testing is automatically enabled when you set the upper and lower limits.
3) set the Counter's run mode when a measurement exceeds the user-entered limits: continue taking measurements or stop making measurements (ON FAIL: GO ON or ON FAIL: STOP).

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

a. Connect input signals to channels 1 of the Counter, the anunciators light.

b. Press 【Freq&Ratio】key and set CH1 frequency until FREQUENCY 1 is displayed, 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 value to be 11.000000MHz.

   Note: make sure to press 【ENTER】key to confirm after setting upper limits.

e. Press 【Uppr&Lower】key until LOWER:********* is displayed.

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 gurantee no problem, 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 annunciators of LIMIT will light.

4.2.8 【High】,【Fast】,【Mid】and【Low】key

User can select the different measurement speed (also meaning the different internal gate). Press any key of the four, the corresponding annunciators will light. Above four keys stands the four gate time accordingly: 10ms, 100ms, 400ms and 1s. User can set the measurement speed according to their need or through 【Gate&ExtArm】key.

4.2.9【Recall】and【Remote/Local】key

1) Under 【Recall】key, the following functions are included: save, recall, unsave, crystal oscillator state of counter, GPIB interface address and RS232 Baud rate, system. When you frst press this key, RECALL: 0 is displayed. Press 【Recall】key again then the counter enter into SAVE function, then following function is UNSAVE, MS OVEN, GPIB address, RS232Baud rate and SYSTEM after press this key again and again. Arrow keys can be used to set under above different menu functions, in which range of GPIB address is from 1 to 30, finally press 【ENTER】key to confirm. 'MS OVEN:000' means the common crystal oscillator is applied to the counter; while 'MS OVEN:001' means the high-stability crystal oscillator is used in this counter. Pay more attention that SYSTEM menu is not avalible for user but preset for debug of manufacturer. Besides, don't forget to press 【ENTER】key to confirm after setting.

2) the initial state of the counter is local, the annunciator of 【Remote/Local】is OFF. Press 【Remote/Local】key until REMOTE or LOCAL is displayed. If 'REMOTE' is displayed and the annunciator light,the counte is in 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 annunciators is OFF. At present the counter is in LOCAL state and can be operated by local key.

Chapter 5 Remote Instruction

5.1 Summary

The programmer commands for the counter are written by referring to SCPI standards. And interface of RS232 and GPIB are support for this counter but it's optional, users should enquiry if they are required. The programmer commands are based on ASCII code, the datas that counter return to computer are also ASCII code, through the remote interface to programmer control the instruments(except of RS232 and GPIB).

5.2 Connection and setting of interface

The RS232 interface of this instrument is universal serial one with 9-pin socket. Using a standard RS232 connection cable can connect the computer and counters. Make sure to power off when connecting. Press 【Recall】key to set the paremeters (Baud rate) of RS232interface. If the communation between computer and counter is diaable, pay attention to the Baud rate setting and check whether they are in line. Change baud rate if necessary.

Use IEEE488 cable to connect the computer and counter and make sure to power off before connecting. The address setting of GPIB interface through pressing 【Recall】key.

The USB interface is in the front panel of the counter, use a piece of standard USB cable to connect the computer and counter. The initial state is LOCAL when powering on. Once enter into REMOTE state, the other keys in front panel except of 【Remote/Local】key are disable. Press 【Remote/Local】key in remote state the counter will 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 (Standard Commands for Programmable Instruments). GPIB common commands are definited with IEEE488.2-1987 standards and be applied to all instruments, but this counter isn'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. Use a colon to separate high-level command and low-level commands

5.3.2 SCPI commands syntax

1) Command keywords and parameter

There are two types for common commands and SCPI commands: parameter and without parameter. Here are some examples:

*RST	without parameter
:FORMat<name>	with parameter (name)
:IMMediate	without parameter

There is at lease one space between keywords and parameter.

Some command words are put in [ ]:, which means these commands are optional, and which can be omissed in programming. For example:

:RANGe[:UPPer] <n>

[:UPPer] means :UUPer is optional and can be selected not to use. This is to say, this command can be sent by the following two ways:

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

Angular bracket < > indicates this option is a parameter value, which will not be included in programming. For example: :HOLD:STATe <b>

<b> means here is a Boolean parameter. If you want to turn on 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 parameter 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.

2) 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 and following words. For example:

:immediate = :imm

Special rules: The following abbreviations of this command only use the first two characters of the keyword:

:Tcouple = :tc

If the forth character in the keyword is a consonant, then remain it and remove tge following charanters. For example,

:format = :form

If this command contains the query sign (?) Or a non-selected numbers in the command keyword, it must be included in abbreviations. For example:

: Delay? =: Del?

Keywords or signs included in square brackets ([ ]) are optional, which can't be included in the programing code.

3) 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) can't be put in the back of colon.

Command for instrument is either can be used in abbreviation format or be used in full format. (block letters must be used in abbreviation format)

Add a interrogation "?" in the end of commands, you can query the current value for this command.

4) Multi-command rules

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

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.

5) Command path rules

Each new program must begin from 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 (:) in the beginning of the program is optional, you can select do not use it. For example:

: INITiate [: IMMediate] = INITiate [: IMMediate]

When theprogram 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 but can not move up upper level, so when the implementation of a high-level command, you need to start from the root 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: a period of time should be retained for counter to respond after computer sending a piece of command then you can let the computer send the second command.

5.4 Programmer commands

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

1. To set trigger level

   [:SENSe]:EVENt[1]:LEVel[:ABSolute] <numeric_value> [V]
2. To select trigger slope

   [:SENSe]:EVENt[1]:SLOPe POSitive | NEGative
3. To set input impedance

   :INPut[1]:IMPedance <numeric_value> [OHM]
4. To set coupling state

   :INPut[1]:COUPling AC|DC
5. To set attenuation ×1

   :INPut[1]:ATTenuation 1
6. To set attenuation×10

   :INPut[1]:ATTenuation 10
7. Filter swtich

   :INPut[1]:FILTer ON | OFF
8. To set Baud rate

   :SYSTem:COMMunicate:SERial:TRANsmit:BAUD <numeric_value>
9. GPIB address

   :SYSTem:COMMunicate:GPIB:TRANsmit:ADDRess <numeric_value>
10. Stop or Signal

:INITiate:CONTinuous OFF

11. Run at full speed

:INITiate:CONTinuous ON

12. Begin to measure

:INITiate[:IMMediate]

13. To mearsure frequency

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

14. To measure frequency ratio

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

15. To measure period

[:SENSe]:FUNCtion[:ON] PERiod [1,2,3]

16. External gate trigger

[:SENSe]: ARM:SOURce EXTernal

17. To set gate time

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

18. To set upper limit

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

19. To set lower limit

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

20. Limit state ON/OFF

:CALCulate2:LIMit:STATe OFF | ON

21. ON FAIL:GO ON

:INITiate:AUTO OFF

22. ON FAIL:STOP

:INITiate:AUTO ON

23. Statistics computation

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

24. To set N value

:CALCulate3:AVERage:COUNt <numeric_value>

25. To set SCALE

:TRACe[:DATA] SCALE <numeric_value>

26. To set OFFSET

:TRACe[:DATA] OFFSET <numeric_value>

27. Math function ON/OFF

:CALCulate:MATH:STATe OFF | ON

28. To set F0

:CALCulate3:AVERage:F0 <numeric_value>

29. To readout the current value

FETCH?

30. Reset

*RST

31. To get the model and version of the counter

*IDN?

'SUIN, SS7301' will return if the counter receive this command.

5.5 Introduction of programmer commands

The initial state of the counter is local state, 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 modified by using the keys in front panel or programmer commands. Concerning to the unit of commands, they are all the international standard units, if you input other units the counter won't recognize. If using a piece of remote commands including unit, the unit can be input or ignored.

If input commands including datas, there are two ways to input, for example, 10000 is equivalent to 1e4, 0.00234 is equivalent to 2.34e-3.

Chapter 6 Service and Surport

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: 86-311-86086971(After-Sales Service) Fax:86-311-86018511

86-311-86014314 (Technical support)

Or contact us by email export@suintest.com

The website is http://www.suintest.com

Chapter 7 Specification

7.1 Working Environment

Temperature: 0 ~ +40℃

Realtive Humility: 20% ~ 90%

7.2 Input Characteristic

7.2.1CH1

Frequency range: when DC coupling 0.001Hz ～ 200 MHz

when AC coupling 1MHz~200 MHz (50Ω On)

when 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 (Step 5mV)

Damage Level:

	50Ω	5Vrms
0 ~ 3.5kHz	1MΩ	350Vdc + ac pk
3.5kHz ~100kHz	1MΩ	350Vdc + ac pk, linearity fall to 5Vrms
> 100kHz	1MΩ	5Vrms

When measuring CH1, for frequency less than 100kHz, please select low pass filter to avoid the possible high frequency in tested low signal.

7.2.2 CH2 (optional)

1) Option1

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) Option2

Frequency range: 200MHz~6.5GHz

Input sensitivity: 200MHz～400MHz ≤-15dBm

400MHz～6GHz ≤-20dBm

6GHz～6.5GHz ≤-15dBm

Max. input power: +13dBm

Damage: +20dBm

7.2.3 CH3 (optional)

1) Option1

Frequency range: 200MHz~6.5GHz

Input sensitivity: 200MHz～400MHz ≤-15dBm

400MHz～6GHz ≤-20dBm

6GHz～6.5GHz ≤-15dBm

Max. input power: +13dBm

Damage: +20dBm

2) Option2

Frequency range: 6.5GHz ~ 12.4GHz

Input sensitivity: ≤-18dBm(Typical)

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

Damage: +25dBm

3) Option3

Frequency range: 6.5GHz ~ 16GHz

Input sensitivity: 6.5GHz～12.4GHz≤-18dBm（Typical）

12.4GHz～16GHz ≤-15dBm（Typical）

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

Damage: +25dBm

7.2.4 External-gate input

Signal input range: TTL level

Pulse width: ≥10μs

External-gate signal: Positive pulse

7.3 Time Base

7.3.1 Internal crystal oscillator

Nominal frequency: 10MHz

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

Note: When plug the power cable of the generator to the sockt, even if you don't press the On/Off switch in front panel, the crystal oscillator has been powered on and the fan begin to work, which is used 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 you can adjust the accuracy through Osc Adjust port in rear panel.

7.3.2 Time base input

Frequency: 5MHz or 10MHz

Amplitude: $\geq1V_{P-P}$

7.3.3 Time base output

Frequency: 10MHz Sine

Amplitude: $\geq2.5V_{P-P}$

7.4 Measurement index

7.4.1 Frequency measurement

CH1 range: 0.001Hz~200MHz

Option 1: 100MHz~3GHz

Option 2: 200MHz~6.5GHz

Option 3: 6.5GHz~12.4GHz

Option 4: 6.5GHz~16GHz

Least significant digits (LSD):

$$\frac{5\times10^{-10}\times Freq}{gate\,time}$$

Gate time: 10μs, 100μs, 1ms, 4ms, 7ms, 10ms, 40ms, 70ms, 100ms, 400ms, 700ms, 1s, 4s, 7s, 10s, 100s, 1000s or input through External gate in the rear panel.

Measurement error:

$$\pm LSD \pm system\,error \pm trigger\,error \pm time\,base\,error \times tested\ \ frequency$$

Trigger error:

$$\frac{(15mV + 0.5\% \times setting\,trigger\,level)\times 2 + noise\,amplitude}{Input\,signal\,slew\,rate\,at\,trigger\ point} \times \frac{Freq}{gate\,time}$$

System error:

$$\frac{1\times10^{-9}\times Freq}{gate\,time}$$

7.4.2 Period measurement

CH1 range: 5ns~1000s

3G option range: 0.33ns~10ns

6.5G option range: 0.15ns~1.6ns

Least significant digits (LSD):

$$\frac{5\times10^{-10}\ s\times Period}{gate\,time}$$

Gate time: 10μs, 100μs, 1ms, 4ms, 7ms, 10ms, 40ms, 70ms, 100ms, 400ms, 700ms, 1s, 4s, 7s, 10s, 100s, 1000s, or input through External gate in the rear panel.

Measurement error:

$$\pm LSD \pm system\,error \pm trigger\,error \pm time\,base\,error \times period$$

Trigger error:

$$\frac{(15mV + 0.5\% \times setting\ trigger\ level) \times 2 + noise\ amplitude}{Input\ signal\ slew\ rate\ at\ trigger\ point} \times \frac{Period}{gate\ time}$$

System error:

$$\frac{1 \times 10^{-9}\ s \times Period}{gate\ time}$$

7.4.3 Frequency ratio measurement

Ratio range: 0.00001~999999

Least significant digits (LSD):

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

7.4.4 Frequency self-test

Display digits and error are same as Frequency measurement in 7.4.1.

7.4.5 Upper/lower limit operation

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

7.4.6 Statistics operation (frequency measurement)

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

Display: repeatedly 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

7.5 General Characteristics

7.5.1 Power conditions

Voltage:	AC220V (1±10%)	AC110V (1±10%)
Frequency:	50Hz (1±5%)	60Hz (1±5%)
Power:	<35VA	<35VA

7.5.2 Remote programmable interface

USB, RS232 are standard and GPIB is optional.

7.5.3 Dimensions and Weight

Dimensions: 375×105×235 mm^3 Weight:3.7kg