User's Guide

SS7406

Universal Frequency Counter/Timer/Analyzer

Suin Instruments Co., Ltd 05/2019

Introduction

SS7406 high resolution time interval 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 highly reliability.

Packing List

SS7406	1
BNC Testing cable	1
Power cord	1
1A 5x20 fuse	2
CD (with user's manual)	1

SS7406 Options

High-stability Crystal Oscillator	1
100MHz~3GHz channel	1
200MHz~6.5GHz channel	1
6.5GHz~12.4GHz channel	1
6.5GHz~16GHz channel	1
200MHz~20GHz channel	1
10GHz~26.5GHz channel	1

Content

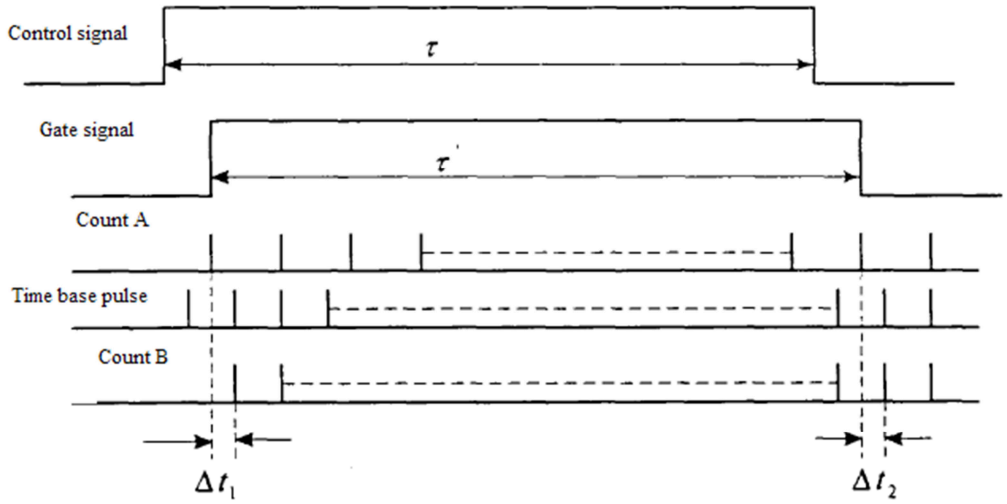
Chapter 1 Main Characteristic

- High accuracy, the measurement resolution can reach to 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 26.5GHz (options)
- ARM is used to bring a higher speed of data processing.
- 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, also the trendgram and histogram of statistical calculation could be displayed.
- Standard interfaces are GPIB, RS-232 and LAN.
- High-stability crystal oscillator is optional.
- 4.3'TFT- LCD, Comfortable vision and clarity, small size and easy to operate

Chapter 2 Principle Summary

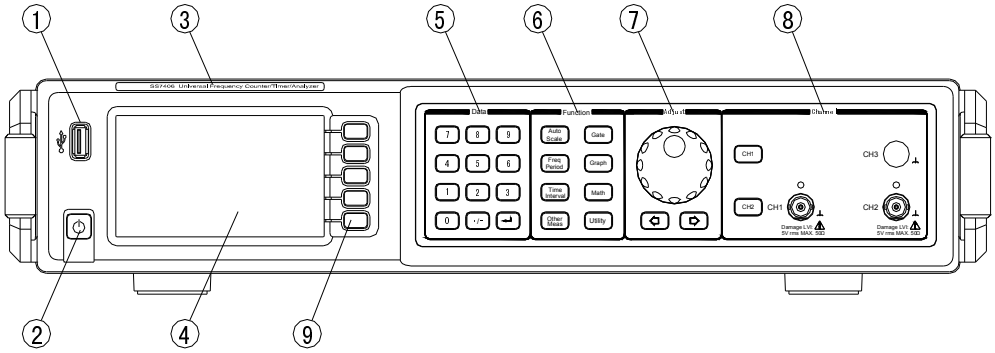
ARM , the control system of counter, make all the functions available, programmed by software designers to memory, user can get desired test results followed by instructions.

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

【01】 USB Host Interface

【02】 Power Switch

【03】 Instrument Sticker

【04】 4.3' TFT LCD

【05】 Numbers Key Area includes numbers 0-9, ./- and enter.

【06】 Function Key Area includes the whole function of the instrument, with the help of the soft keys in area 【09】 when using

【07】 Knob and Left/Right Keys

【08】 BNC interface and selection keys for CH1 and CH2

3.1.2 Keys and it's function introduction

【05】 The Number Key Area is used to input the numbers when need. It's mainly used to set the Gate, trigger level, mathematics function, system setting, etc.

【06】 Function Area includes keys of 【Auto Scale】, 【Freq/Period】, 【Time Interval】, 【Other Meas】, 【Gate】, 【Graph】, 【Math】 and 【Utility】.

【Auto Scale】can be set in【Utility】-【OtherSetup】. It has two options: Preset and USB Store. When Preset is selected, parameters in instrument will be totally reset when pressing 【Auto

Scale】. When USB Store is selected, after pressing 【AutoScale】, insert a U disk, USB storage can

be used, detailed information please refer to the next pages in USB storage part.

【Freq/Period】, when it is pressed, 'Freq', 'Period', and 'Freq Ration' will be appeared in the right side of screen in turn. Then press soft keys in【09】area accordingly to enter menu of above three functions. Enter secondary menu of Freq/Period, later select the frequency or period function, output CH1or CH2 or CH3, turn on or off Auto Level.

When Auto Level is ON, you can only set the trigger level percent. When it is OFF, you can set the trigger level value. In most situation, real measured values, Vpp, Vmin and Vmax, will be appeared in the screen, which indicates peak-peak value, maximum and minimum value separately. This three values has great relations with input signal's frequency and waveform, so there are errors in the real time voltage measuring. The voltages here are just a reference for customers setting trigger level, which can't be regarded as the signal's accurate voltage to test.

Freq Ratio includes 1/2 and 2/1 two options.

【Time Interval】 includes functions of Time Interval, Pulse Width, Duty cycle, Rise/Fall, Phase

【Other Meas】 includes functions of accumulating counting and DVM.

【Gate】includes 'Source INT/EXT' and 'Gate Time'.

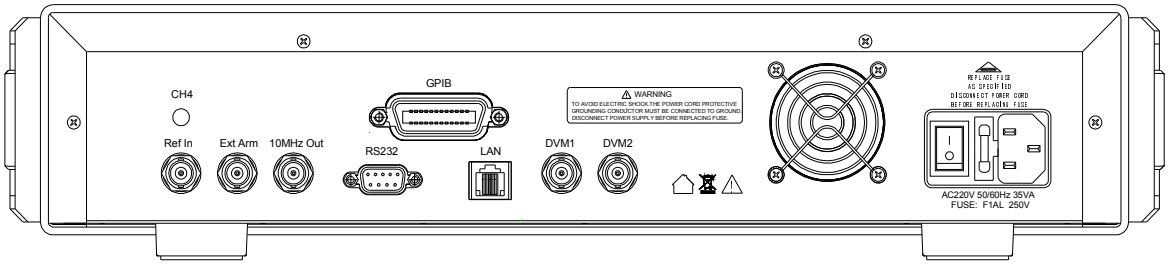
【Graph】, firstly choose the measuring function and then press it, the screen will display the trendgram or histogram. Number point of every screen is 100.

【Math】, press it to choose limit calculation, statistic calculation or Scale/Offset calculation.

【Utility】, includes interface setting, built-in crystal oscillator regulation, system setting, etc.

The function keys are transparent with blue LED indicator, of which will be turned on or off when enable or disable a function.

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

RS-232 Remote interface RS-232

LAN Network interface

DVM1 Input port 1 of voltage measurement

DVM2 Input port 2 of voltage measurement

CH4 Output of adding option 26.5GHz

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

Chapter 4 Operation Instructions

4.1 Before measuring

4.1.1 Preparation before Measuring

Please check whether the power supply and voltage are within the limit range of this counter, and then 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.**

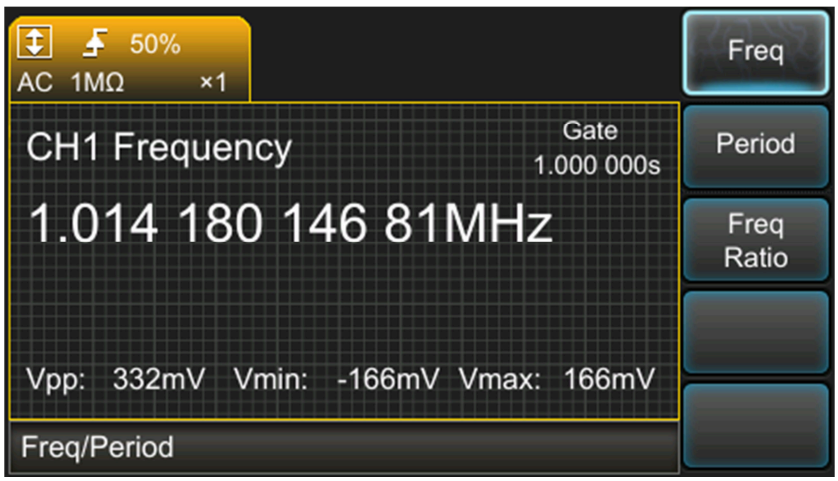
4.1.2 Power on

Press power key on the front panel, the instrument enter into initialization state, then screen displays manufacturers logo, model and name. 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 Frequency Measuring



After Initiation the instrument will enter the state of frequency measuring of CH1. In other condition, press 【Freq/Period】then enter to this function directly, default is CH1's frequency measuring. Displaying as above. In this interface, you can enter the secondary function menu

through the blue soft key beside right of display, frequency of CH1, CH2 or CH3 could be selected.

After choosing the frequency function, connect the tested signal to BNC interface at the front panel. Normally there are signal indicators in CH1 and CH2, of which will flicker if the input signal is connected with device successfully and the speed of flicker is in direct proportion to the input signal's frequency. There is no signal indicator in CH3.

Then SS7406 begins to measure the frequency of input signal, and the real time result will be displayed and refreshed in the screen. Gate will be flicker too. Refreshing speed rate is consistent with the Gate time, of which default setting is 1s.

Vpp, Vmin and Vmax will display in the screen at the same time which stands for the peak-peak value, minimum value and maximum value of the external input signal separately. The voltage result is affected greatly by input signal's frequency, so there are errors in the voltage measuring. It only provides a basic reference for users in actual measurement, especially in the trigger level setting.

When using SS7406 to measure the frequency signal, if you want to get a stable and accurate result, the right channel setting is necessary because any unexpected state in the tested signal inputting will be happen.

【Return】 means to return to the previous menu in the whole interface of operating and setting.

4.2.2 Channel Setting

Channel setting includes 【AC/DC】, 【1MΩ/50Ω】, 【BW Limit】, 【×1/×10 ATT】, 【Sense Low/Mid/High】, 【Trigger Level】and 【Common】.

In the measuring condition, press 【CH1】 or 【CH2】 in the front panel, the instrument enters the setting menu of chose channel. Compared to 【CH1】setting, 【CH2】setting has all the functions except of 【Common】. 【Common】 means CH1 channel is common, there are two options "Off" and "On". When it is "On", CH1 channel is commonly used, at this time, it is no use whether there is input signal or not in CH2. Because CH1's signal is already sent to CH2 through device's built-in control circuit.

As to the soft keys which are corresponding to 【AC/DC】, 【1MΩ/50Ω】, 【Common】, it will switch once each press once. The selected function or default function is appeared with black character on white background in the screen. Some function menu is also with black character on

white background, which means you can press the correspondent key to choose more setting. As to 【Trigger Level】, there is down arrow in the key displaying area, which means there is a secondary menu, which you can press to set and display more in detail. This rule applies to this instrument's other function.

【AC/DC】 is used to set the status in the corresponding channel is AC coupling or DC coupling.

【1MΩ/50Ω】 is used to set the impedance of correspondent channel. You can choose the high impedance (1MΩ) or low impedance (50Ω) according to the actual needs. Normally make sure that the tested signal's impedance is matched with the instrument' channel impedance setting.

【BW Limit】 is used to open or close the 100kHz low pass filter. When testing the signal less than 100kHz, you'd better open it so as to filter the high frequency noise in the low frequency signal to ensure get a more stable result.

【×1/×10 ATT】 is a switch of attenuation function. When the input signal is out of the specified input range, the testing result will be not stable or right. Now you can open the ×10 attenuation function, then the built-in circuit will attenuate the input signal for 10 times, which can make it more suitable for the testing.

【Sensitive】 includes three items: Low, Mid and High. Choosing different trigger sensitive is actually setting the Hysteresis active region range for the instrument's trigger level. In normal condition, if there is louder noise in the signal, you should choose Low. Default state is Mid.

【Trigger Level】 includes ON/OFF for 【Auto Level】, setting for the trigger level's percent/value and 【Slope】 which is used to select the trigger edge.

【Auto Level】 can set the trigger level to auto sampling or manual sampling. If it is On, default state is to automatically sample the input signal's peak voltage, with 50% trigger level. You can also change the trigger level percent by hand in【Level %】. If it is Off in【Auto Level】, the auto sampling is turned off. Now you can set the trigger level by 【Level】, with range -5.000V--+5.000V, step value 1mV.

【Common】 is the control key use CH1 in common, which is presented above. Off means to turn off common function. On means to enable use CH1 in common then CH1's input signal with be shared on CH1 and CH2 at the same time and it makes no difference whether there is signal or not in CH2.

4.2.3 Adjust Area in Front panel

This area includes adjusting knob and direction keys【→】and【←】. When you want to adjust a value, please use 【→】、【←】to select the digit you want to change then decrease or increase the value of selected digit by knob.

4.2.4 Frequency Ratio

Set this function through the below operational process:

【Freq/Period】 →broadside key【Freq Ratio】 →【Freq Ratio1/2】 or 【Freq Ratio 2/1】

If you want to test the Frequency Ratio, please make sure there are signal input both in CH1 and CH2. When it is worked, the two channel's frequency ratio will be displayed in the screen, at the same time the frequency value and the peak to peak value are also displayed with small font at the bottom of screen.

4.2.5 Time Interval

Set this function through the below operational process:

【Time Interval】 →broadside key【Time Interval】 →【Time Int 1-2】 or 【Time Int 1-1】

You can set the start signal and stop signal's trigger level percent or actual level value through 【Start CH Level】 and 【Stop CH Level】.

4.2.6 Pulse Width

Set this function through the below operational process:

【Time Interval】→Broadside key【Pulse Width】→【Width】→【Pos】or【Neg】

【Pos】, means measurement of positive pulse width, is the default status.

【Neg】, means measurement of negative pulse width. The measurement of pulse width is valid for CH1 only.

4.2.7 Duty Cycle

Set this function through the below operational process:

【Time Interval】→Broadside key【Duty Cycle】→【Duty Cycle】→【Pos】or【Neg】

【Pos】is the default status, which means the ratio of positive pulse width to signal period. 【Neg】means the ratio of negative pulse width to signal period. It is valid for CH1 only.

4.2.8 Phase Difference

Set this function through the below operational process:

【Time Interval】 →broadside key【Phase】 →【Phase 1-2】

Phase difference's measuring principle: input two signals separately to CH1 and CH2, the instrument will test the time difference T1 of the two signals, also test the period T2 of CH1 through the formula: Ph=(T1÷T2)×360°

The final result is the two signal's phase difference. At the same time, the screen will also display the Vpp Vmin and Vmax of CH1's signal.

4.2.9 Accumulating Count

Set this function through the below operational process:

【Other Meas】 →broadside key【Totalize】 →【CH1】 or 【CH2】

This function can accumulate the number of input signals and display it. At the same time, the screen can also display the Vpp Vmin and Vmax of the tested signals. Here the Gate flickers, which means data refresh but not the setting Gate time.

4.2.10 DVM

Set this function through the below operational process:

【Other Meas】 →broadside key 【DVM】

DVM is used to test the voltage of DC signal which is input to DVM1 or DVM2 in rear panel with the measurement range ±1.999 VDC or ±19.99 VDC. You can select the measurement channel through the secondary menu of 【DVM】, then select measurement range from the three configured options Auto, 2V and 20V according to the tested DC voltage value.

4.2.11 Gate Setting

This function is only available under function of frequency, period, frequency ratio, duty cycle, phase difference, etc..

In Gate menu, the Gate Source namely 【Source】, which contains internal Gate 【Int】 and external Gate【EXT】. Default is internal gate. When【Int】is selected, users can set the Gate time through the knob or number keys, of which the Minimum step value is 1μs, minimum value is 1μs, and maximum value is 1ks.

When【Ext】 is selected, users need to input a Square with TTL at the EXT ARM port in the rear panel, with pulse width ≥50ns. Now the Gate time can't be set, but the external pulse's polarity , positive or negative , can be selected through sequence【Polarity】 →【Pos】 or 【Neg】.

4.2.12 Graph function

Firstly user set the measured function, then press 【Graph】, the instrument will display trend graph of current function in default. Each screen will display 100 testing point and display next with automatically rolling mode. X-axis displays the numbers of measuring point and Y-axis displays the actual measurement value. While Y-axis' range changes automatically according to the actual measurement value. On the top of the screen, it displays the maximum and minimum value of the Y-axis and also the total number of samples.

Except of【Trend Chart】, users can also choose【Histogram】to display in this function.

4.2.13 MATH Operation

MATH Operation namely 【Math】 includes 【On】/【Off】, 【Statistics】, 【Limits】,【Scale】.

【Statistics】: When enable【Math】is started, which is also means enable【On】of【Statistics】, the screen will display the minimum value 【Min】, maximum value 【Max】, average value 【Mean】, peak to peak value 【PtP】, Allan Deviation 【ADev】 and the total numbers of sampling 【Count】. 【PtP】 and 【ADev】 can't be displayed simultaneously, and only one can be chose through press 【Show】under statistics function. 【PtP】 and 【ADev】 can only be switched under the frequency measuring function, in other functions 【PtP】 will be the default display.

Formula will be used in 【Statistics】:

The measuring average value for N times **Mean** Mean=$\frac{1}{N}\sum_{i=1}^{N} Fi$

The measuring maximum value for N times **Max** Max= the maximum value in the N times measuring

The measuring minimum value for N times **Mi**n Min= the minimum value in the N times measuring

Standard deviation measuring SDev: SDev=$\sqrt{\frac{N\sum_{i=1}^{N} Fi^2 - (\sum_{i=1}^{N} Fi)^2}{N(N-1)}}$

Allan deviation measuring ADev: ADev=$\sqrt{\frac{\sum_{i=1}^{N-1} (F_{i+1} - F_i)^2}{2(N-1)}}$

【Limits】: Before opening this function, users should set 【Lower Value】 and 【Upper Value】, which can be automatically set by the system between the real tested maximum and minimum value.

【Scale】: it includes two functions, standard deviation calculation and proportional migration calculation. When initially enter this function, it is off, you should choose 【Scale On】 to turn it on. Then you can set it in the secondary menu of 【Function】in detail, default status is 【Null】. Now the measuring result in screen is: display value=measured value=reference value, reference value namely【Ref Value】 can be set manually, or get the last measured value as reference value automatically through pressing 【Get New Reference】.

Default function is 【Function Null】. After opening the sub-menu under 【Function】, users can choose 【Null】, 【PCT】, 【PPM】, 【PPB】 and 【Mx_B】.

【Null】: show value=measured value-reference value

【PCT】: show value=(measured value-reference value) ÷reference value×100, unit mpct

【PPM】: show value=(measured value-reference value) ÷reference value×1E3, unit mppm

【PPB】: show value=(measured value-reference value) ÷reference value×1E6, unit mppb

【Mx_B】: if 【Invert x】is 【Off】, show value=measured value×M-B

If 【Invert x】is 【On】, show value=(1÷measured value) ×M-B

4.2.14 System setting

Press 【Utility】key to enter the system menu, default setting is I/O Setup. Press the side button 【I/O Setup】, default interface is LAN and that's 【I/O LAN】. Then press 【I/O LAN】 again to enter the sub-menu to choose and set the RS232 and GPIB interface according to actual needs.

After selected the interface, users can set the configuration parameter as follows:

DHCP: On, automatic allocate IP address; Off, manually allocate IP address. With On is selected, that is no need to set other parameters, press to save and system will automatically allocate other parameters.

IP address setting: set a useful IP address, eg. 192.168.1.10

Submask setting: 255.255.255.0

GateWay setting: if IP address is 192.168.1.10, GateWay will be 192.168.1.1

After setting the parameter, users should press Save to make it valid. Then use the telecommunication cable to connect the instrument and PC.

If select RS-232 interface, users can set RS-232 interface's parameter, default Baud Rate is 115200, no parity check bit,1 stop bit.

If select GPIB interface, users can set the GPIB interface's parameter, default programmable address is 15.

After entering system menu 【Utility】, users can also choose 【Crystal Oscillator】, 【System Parameter】, 【Other Setup】, 【Help】, 【State Save】and 【State Recall】.

If adjusting the internal crystal oscillator's accuracy, users should connect the output 10MHz or 5MHz to CH1 through a piece of BNC cable, then enter 【Crystal Oscillator】, screen will display the measured result. Input the voltage value with numeric keys and then select its unit V or Mv and finally press 【Confirm】, screen will popup 'Setup Successfully!', then press 【OK】.

After pressing 【System Parameter】, screen will display a dialogue box to let user input password, please enter '123456', then press【Enter】to confirm it. The instrument will enter the menu of system parameter setting and calibration, of which【CH1 Offset】【CH2 Offset】【CH1 Sense】【CH2 Sense】【DVM1】【DVM2】 are reserved for debugging staff, please don't adjust them without special situation or without communication with our technicians.

If the working environment is changed or there are some bigger measurement errors, please contact our technicians, then operate 【System Calibration】. Before operation, please disconnect the signals on the BNC interfaces, after two times confirmation, the instrument will enter auto calibration process and which will last 3~5minutes. If the calibration is not successful, please power it off and power it on again, then enter calibration menu to restart the calibration.

4.2.15 USB storage to store and display data

Firstly press 【Utility】 to enter the system menu, 【Other Setup】-【AutoScale Multiplex】, choose 【USB Store】, then 【AutoScale】 can be used to save USB data or pictures.

 will be displayed when U disk is inserted,  will be displayed when data or pictures are storing. During data or pictures storing, other operations are forbidden. Other operation will be allowed as soon as press 【AutoScale】key to terminal the save.

USB storage function is only available for data measurement and Graph display under Freq/Period and TimeInterval function. In data measuring interface, measured data not included Vpp/Vmin/Vmax will be stored when pressing 【AutoScale】. In Graph interface, screenshot will be stored.

During store the measurement data, you can set some parameters according to the prompt after pressing 【AutoScale】. Details are as follows:

1. Set the folder name or file name, editable. If there is already a file or folder named that, you can decide whether to cover it or not.

2. Set the maximum number of stored data. Once surpass the set limits, it will delete the earliest stored data automatically then save the newest data.

When storing pictures, it will be stored to the appointed folder under Graph according to different functions, including Frequency, Period, FreqRatio, TimeInterval, PulseWidth, DutyCycle, RiseFall, Phase. This step is default and users can't set up. As well, you can also set some parameters according to the prompt after pressing 【AutoScale】:

1. Set time interval N of screenshot, then get one screenshot every N minute and store it to U Disk.

2. Set the maximum number of stored picture. Once it surpasses the setting limits, it will delete the earliest stored pictures automatically then store the latest ones.

Through 【Utility】-【Other Setup】-【Open Udisk】, you can check the U disk's content. You can open a folder, create a file or folder, rename it, and delete it.

4.2.16 To save and recall setting state parameters

Press 【Utility】-【Next】-【State Save】or 【State Recall】.

The instrument can store at most 50 groups of setting state parameters. When save state, there are 50 memory locations with sequence number 1 to 50. Each memory location could be used repeatedly and the last storage will be covered if user stores a new state in same location. When recall the state, at most 51 groups of setting states

parameters with sequence number 0 to 50 could be used. While the location 0 is default initial state of device setting, which could be only used to recall but not save. Under this function, the save or recall state before power off device will be the default state of device when reboot it next time.

Press 【State Save】, 'Location No.' will appear the display interface, input a desired number from 1 to 50 directly by numerical keys and press 【Enter】key to confirm the selecting location, press 【State Save】 to finish the save operation.

Press 【State Recall】,'Location No.' will appear the display interface, input a desired number from 0 to 50 directly by numerical keys and press 【Enter】key to confirm the selecting location, press 【State Recall】 to finish the recall operation.

4.2.17 System Update Function

By pressing 【Utility】-【Other Setup】-【System Update】, you can set server's IP, port number, user name, passport. After setting up, press 【Update】 to update the system. After finishing update, reboot the instrument.

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 Interface Connection and Setting

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. The default serial port is 8 bit, one stop bit, no odd-even check and Baud rate is 115200.

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. Default program control address is 10.

5.3 Programmable Command

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 Programmable Command

Below are the detailed introduction and some specific requirements of the programmable

1. To measure frequency
   [SENSe:]FUNCtion:FREQuency 1|2|3
2. To measure period
   [SENSe:]FUNCtion:PERiod 1|2|3
3. To measure Frequency Ratio
   [SENSe:]FUNCtion:FREQuency:RATio 1/2|2/1
4. Totalize
   [SENSe:]FUNCtion:TOTalize 1|2
5. DVM
   [SENSe:]FUNCtion:DVM 1|2
6. To measure time interval
   [SENSe:]FUNCtion:TINTerval 1-2|1-1
7. To measure phase difference
   [SENSe:]FUNCtion:PHASe 1-2
8. To measure duty cycle
   [SENSe:]FUNCtion:DCYcle 1
9. To measure positive pulse-width
   [SENSe:]FUNCtion:PWIDth 1
10. To measure negative pulse-width
    [SENSe:]FUNCtion:NWIDth 1
11. To measure rise time
    [SENSe:]FUNCtion:EDGE:RISE 1
12. To measure fall time
    [SENSe:]FUNCtion:EDGE:FALL 1
13. To query the current measurement function
    [SENSe:]FUNCtion?
14. To set/query Gate source
    [SENSe:]ARM:SOURce EXTernal|INTernal
    [SENSe:]ARM:SOURce?
15. To set/query Gate time
    [SENSe:]ARM:TIMer <numeric_value> [us|ms|s|ks]
    [SENSe:]ARM:TIMer?
16. To set/query slop of start signal
    [SENSe:]TINTerval:ARM:STARt:SLOPe POSitive | NEGative
    [SENSe:]TINTerval:ARM:STARt:SLOPe?
17. To set/query slop of stop signal
    [SENSe:]TINTerval:ARM:STOP:SLOPe POSitive | NEGative
    [SENSe:]TINTerval:ARM:STOP:SLOPe?
18. ON/OFF or query Math function
    CALCulate[:STATe] OFF | ON

CALCulate[:STATe]?

19. ON/OFF and status query for Scale function
    CALCulate:SCALe[:STATe] OFF | ON
    CALCulate:SCALe[:STATe]?
20. To set/query opertion function under Scale
    CALCulate:SCALe:FUNCtion NULL|PCT|PPM|PPB|SCALe
    CALCulate:SCALe:FUNCtion?
21. To set/query reference value in Scale operation
    CALCulate:SCALe:REFerence <value>F|P|N|U|M|K|MA|T|PA
    CALCulate:SCALe:REFerence?
22. To set/query gain value in Scale operation
    CALCulate:SCALe:GAIN <value>F|P|N|U|M|K|MA|T|PA
    CALCulate:SCALe:GAIN?
23. To set/query offset value in Scale operation
    CALCulate:SCALe:OFFSet <value>F|P|N|U|M|K|MA|T|PA
    CALCulate:SCALe:OFFSet?
24. To set/query Reciprocal function in Scale operation
    CALCulate:SCALe:INVert OFF | ON
    CALCulate:SCALe:INVert?
25. To set/query Statistic function
    CALCulate:AVERage[:STATe] OFF | ON
    CALCulate:AVERage[:STATe]?
26. To query average value in current statistic operation
    CALCulate:AVERage:MEAN?
27. To query Minimum value of current statistic operation
    CALCulate:AVERage:MINimum?
28. To query Maximum of current statistic operation
    CALCulate:AVERage:MAXimum?
29. To query difference value of current statistic operation
    CALCulate:AVERage:PTPeak?
30. To query Allen Variance value of current statistic operation
    CALCulate:AVERage:ADEViation?
31. To query standard deviation of current statistic operation
    CALCulate:AVERage:SDEViation?
32. To query sample count of current statistic operation
    CALCulate:AVERage:COUNt?
33. To query all status of current statistic operation
    CALCulate:AVERage:ALL?
34. ON/OFF and query of limit operation
    CALCulate:LIMit[:STATe] OFF | ON
    CALCulate:LIMit[:STATe]?
35. To set/query upper limit value
    CALCulate:LIMit:UPPer[:DATA] <value>F|P|N|U|M|K|MA|T|PA
36. To set/query lower limit value

CALCulate:LIMit:LOWer[:DATA] <value>F|P|N|U|M|K|MA|T|PA
CALCulate:LIMit:LOWer[:DATA]?

37. To set/query input impedance
    INPut[1|2]:IMPedance 50|1M
    INPut[1|2]:IMPedance?
38. To set/query AC/DC coupling
    INPut[1|2]:COUPling AC|DC
    INPut[1|2]:COUPling?
39. To set/query attenuation
    INPut[1|2]:ATTenuation *1ATT|*10ATT
    INPut#:ATTenuation?
40. ON/OFF and Query 100kHz lowpass filter
    INPut[1|2]:FILTer OFF|ON
    INPut[1|2]:FILTer?
41. To set/query voltage value of trigger level
    INPut[1|2]:LEVel [:ABSolute] <value>
    INPut#:LEVel#[:ABSolute]?
42. To set/query voltage ration of trigger level
    INPut[1|2]:LEVel:RELative <value> Note: range of value is 10 to 90
    INPut[1|2]:LEVel:RELative?
43. ON/OFF and query auto trigger level
    INPut[1|2]:LEVel:AUTO OFF|ON
    INPut[1|2]:LEVel#:AUTO?
44. To set/query trigger slop of channel
    INPut[1|2]:EVENt:SLOPe POSitive|NEGative
    INPut[1|2]:EVENt:SLOPe?
45. Read the measurement result
    FETCh?
46. To set/query Baud rate of RS232
    UTILity:RS232:BAUD 2400|4800|9600|19200|38400|57600|115200
    UTILity:RS232:BAUD?
47. To set/query GPIB remote address
    UTILity:GPIB:ADDRess <1~30 >
    UTILity:GPIB:ADDRess?
48. Reset commands
    *RST
49. To query model number
    *IDN?
50. To query system error message
    SYSTem:ERRor?
51. To clear status
    *CLS

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 115200, 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 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 repair 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 8:30-17:15 GMT

Tel: 86-311-83897147

Fax: 86-311-83897040

Or contact us by email export@suintest.com

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

Chapter 7 Specification

7.1 Working Environment

Temperature: 0 ~ +40℃

Relative Humility: 20~80%

7.2 Input Characteristic

7.2.1 CH1 &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: 100MHz~3GHz

Dynamic Range: -27dBm~+19dBm Sine

Input impedance: 50Ω

Coupling mode: AC

3) Option 3

Frequency range: 200MHz ~ 6.5GHz

Input sensitivity: ≤-15dBm

Max. input power: +13dBm

Damage level: +20dBm

4) Option 4

Frequency range: 6.5GHz ~12.4GHz

Input sensitivity: ≤-15dBm (Typical Value)

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

Damage level: +25dBm

5) Option 5

Frequency range: 6.5GHz ~16GHz

Input sensitivity: ≤-15dBm (Typical Value)

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

Damage level: +25dBm

6) Option 6

Frequency range: 200MHz~20GHz

Input sensitivity: 200MHz~350MHz ≤-10dBm (Typical Value)

350MHz~18GHz ≤-15dBm (Typical Value)

18GHz~20GHz ≤-10dBm (Typical Value)

Max input power: +10dBm

Damage Level: +25dBm

7) Option 7

Frequency range: 10GHz~26.5GHz

Dynamic range: -20dBm~+10dBm (10GHz~20GHz) *
-15dBm~+10dBm (20GHz~24GHz) *
-10dBm~+10dBm (24GHz~26.5GHz) *
Damage Level: +20dBm
*Standard provided accessory should be connected externally when input signal is greater than 0dBm.

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}
Daily Aging rate	1×10^{-8}/day	5×10^{-10}/day
Yearly aging rate	5×10^{-7}/year	5×10^{-8}/year

Note: Around 30 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 【**Utility**】key, please refer to 【**Utility**】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: $\sqrt{\frac{(25\text{ps typ.}【75\text{ps max.}】)^2+(0.2\text{ppb} \times \text{Interval})^2}{\text{N}}}$

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

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 ≥20ns, period<1000s, the smaller pulse width is, the bigger the error is.

Duty cycle measurement range: 1~99%

Measurement error:

±0.01%±RMS±(trigger level error±time base error×time interval±1.5ns) ×measured signal's frequency×100%

In which:

Measurement accuracy (RMS):

$$\pm\sqrt{(t_{res}{}^2 + 2 \times trigger\ \ jitter\ error^2) \times (1 + duty\ cycle^2)} \times measured\ \ frequency \times 100\%$$

$t_{res}= 5.0\times 10^{-11}$

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 measures the processing time.

Measurement error: < ±(1 ns × Freq × 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× $10^6/F_0$, 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, RS232 and LAN

7.6.2 Power conditions

	Standard:	Optional:
Voltage:	AC220V (1±10%)	AC110V (1±10%)
Frequency:	50Hz (1± 5%)	60Hz (1± 5%)
Power:	<70VA	<70VA

7.6.3 Dimensions: 454×97.5×480(mm)^3 Weight: approx.7.3kg